Vi Microsystems Pvt. Ltd.,

Innovation in Educational Trainers

POWER ELECTRONICS TRAINERS

Product Catalogue

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POWER ELECTRONICS TRAINERS

PART - I SCR RELATED PRODUCTS

I. SCR CHARACTERISTICS TRAINER

1. IGBT, MOSFET, SCR, TRIAC, DIAC Characteristics Study Trainer (PEC16M1-A)

* Basic static characteristics study trainer.
* LM723 based variable DC power supply (0-30V) for SCR V_{ak}.
* LM723 based variable DC power supply (0-12V) for gate voltage of all devices.
* Separate section for SCR/TRIAC characteristics.
* Separate section for IGBT/MOSFET characteristics.
* Two No's fixed load resistor for all devices.
* Four No's potentiometer to vary all voltages.
* LED indication for all power supply.
* Three No's. digital multimeter for measurement of device parameters.
* 230V AC input with Power ON/OFF switch.

Suggested Experiments

1. Study of VI characteristics of SCR.
2. Study of VI characteristics of TRIAC.
3. Study of Transfer characteristics of MOSFET.
4. Study of Transfer characteristics of IGBT.

2. SCR VI Characteristics Study Trainer (PEC16M1B)

* Basic VI characteristics study trainer.
* Consists of one no. TYN612 SCR with heat sink.
* LM723 based 20V DC power supply for gate voltage.
* One no. potentiometer used to vary the gate current
* 0 - 30V DC variable power supply for anode, cathode voltage variation.
* One no. potentiometer used to vary the V_{ak}.
* One no. high voltage fixed load resistor.
* One no. toggle switch to ON/OFF gate voltage.
* Two no. DC ammeter, voltmeter/multimeter provided to measure I_g & V_{ak}, I_a.
* 230V AC input . Power ON/OFF switch.
* All components are mounted on a screen printed PCB fixed on a nice wooden cabinets.

Suggested Experiments

1. Static anode-cathode (VI) characteristics of SCR at different gate current.

3. TRIAC VI Characteristics Study Trainer (PEC16M1C)

* Basic VI characteristics study trainer.
* Consists of one no. BTA12 TRIAC with heat sink.
* LM723 based 20V DC power supply for gate voltage.
* One no. potentiometer used to vary the gate current.
* 0 - 30 / 50V DC variable power supply for voltage variation.
* One no. potentiometer used to vary the Vmt1, mt2 . One no. high wattage fixed load resistor
* One no. toggle switch to ON/OFF gate voltage.
* Two no. DC ammeter, voltmeter / multimeter provided to measure device parameters.
* 230V AC input. Power ON/OFF switch with indication.
* All components are mounted on a screen printed PCB fixed on a nice wooden cabinets.

Suggested Experiments

1. Static (VI) characteristics of TRIAC at different gate current.

4. DIAC VI Characteristics Study Trainer (PEC16M1D)

* Basic DIAC VI characteristics study trainer.
* Consists of one no. DIAC with proper heat sink.

* 30V DC variable power supply for MT1, MT2 voltage variation.
* One no. potentiometer used to vary the MT1/MT2 voltage. One no. high wattage fixed load resistor.
* One no. toggle switch to ON/OFF DC voltage.
* Two No's DC ammeter, voltmeter/ multimeter provided to measure device parameters.
* 230V AC input. Power ON/OFF switch LED indication.
* All components are mounted on a screen printed PCB fixed on a nice wooden cabinets.

Suggested Experiments

1. Static (VI) characteristics of DIAC.

5. Transient Characteristics of SCR and MOSFET (VPET-216)

a) Transient Characteristics of SCR

* One SCR (TYN 612) with proper heat sink
* Turn-ON transient (OR) turn off transient characteristics can be studied.
* IC Based square wave generation for V_{AK} and V_{GK}
* One No. of fixed load resistor.

b) Transient Characteristics of MOSFET

* One IRF840 MOSFET with heat sink
* One no. 15V/30V power supply (Built-in) for V_{DS}
* One no. of 555 based square wave generation with transistor driver circuit
* One no. of fixed load resistor.

c) Power Supply

* 230V AC Input, ±15V DC for control circuit
* Power ON/OFF switch with indication.

6. Dynamic Characteristics of SCR & TRIAC (VPET-216A)

This set up is designed to study the TURN ON & TURN OFF Characteristics (Dynamic characteristics) of SCR and TRIAC devices. This set up consists of.

Features

* One number of SCR with proper heat sink is provided.
* One number of TRIAC with proper heat sink is provided.
* One no of Square wave pulse generator circuit is provided for SCR, TRIAC Gate circuit
* One no of potentiometer is provided for Gate circuit Square pulse amplitude adjustments.
* One number of Fixed R Load is provided for SCR circuit.
* one number of Fixed R Load is provided for TRIAC circuit.
* Current sensing resistor is provided for SCR, anode current measurement.
* Current sensing resistor is provided for TRIAC, current measurement.
* One number of square wave pulse generator circuit is provided for SCR, Anode cathode circuit & TRIAC circuit.
* All necessary block outputs are terminated by 4m connectors by external patching
* All are mounted on wood box with diagram printed PCB
* 230V AC input with power ON/OFF switch.

7. Construction of SCR Using Two Transistor [PEC16M1F]

* One No. of NPN transistor & PNP Transistor provided for SCR circuit.
* One No. DC voltage source for SCR in DC mode operation.
* One No. 24V AC voltage source for SCR in AC mode operation
* Simple firing circuit with firing angle variation for AC mode operation

II. SCR TRIGGERING CIRCUITS TRAINERS

A. TYPES OF TRIGGERING MODULE

1. R,R-C UJT Firing Module (PEC14M12)

* Consists of three types of basic firing circuit to trigger SCR.
* Separate sections for R - firing , RC - firing , UJT firing circuit.
* 24V AC / 1AMP provided for firing circuit input voltage.
* One potentiometer used to vary the firing angle of UJT firing circuit.
* One potentiometer used to vary the firing angle of R - firing circuit.
* One potentiometer used to vary the firing angle of RC - firing circuit.
* One no. toggle switch for ON/OFF 24VAC.
* Four No's of firing pulses terminated on the front panel for connecting external device module. (UJT firing circuit)
* 1:1:1 Pulse transformer used for UJT firing circuit pulse isolation.
* One no of SCR with snubber circuit forms half wave controlled converter circuit for checking all the three firing circuit.
* 230V, 50HZ AC input, fuse provided for over load protection.
* One no. of rocker switch with LED indication for power ON/OFF.

Suggested Experiments

1. Study of UJT firing circuit.
2. Single phase half wave controlled converter using UJT firing.
3. Single phase half wave controlled converter using R - firing.
4. Single phase half wave controlled converter using RC - firing.

2. 555 Firing Module (PEC14M13)

* 555 Timer based SCR triggering pulse generation.
* Four No's firing pulse to trigger SCR for AC converters / regulators applications.
* 1:1:1 Pulse transformer used for pulse isolation.
* One no.of potentiometer used to vary the firing angle (180° - 0°).
* All four pulses terminated on the front panel for external interface with SCR device module (PEC14M15).
* 24V AC / 1AMP for power circuit input voltage.
* One no of toggle switch for ON/OFF 24VAC.
* One no. of SCR with snubber circuit forms half wave controlled converter circuit for checking the firing circuit.
* 230V, 50HZ AC input, fuse provided for over load protection.
* One no. of rocker switch with LED indications for power ON/OFF.

Suggested Experiments

1. Study of 555 firing circuit.
2. Single phase half wave controlled converter using 555 firing.
   * By external interface with SCR device module (PEC14M15) the following experiments can be connected additionally.
3. Single phase half controlled converter using 555 firing.
4. Single phase fully controlled converter using 555 firing.

3. Line Synchronized Triggering Module(Single phase fully controlled bridge convert) (PEC14M14FW)

* Line synchronized IC based linear firing circuit,
* Line synchronization achieved by step-down transformer.
* Four No. firing pulses to trigger four SCRs.
* 1:1:1 Pulse transformer used for SCR gate pulse isolation.
* One No . potentiometer used to vary the firing angle (180° - 0°).
* All four pulses terminated on the front panel for external SCR device module(PEC14M15) interface.
* Carrier logic implemented for SCR self - start, carrier frequency 4KHz.
* Debounce logic circuit implemented for gate pulse ON/OFF.
* One No . toggle switch provided for gate pulse ON/OFF.
* 230V, 50Hz AC input, fuse provided for over load protection.
* One No. rocker switch with LED indication for power ON/OFF.
* Provision to control the firing angle through external [0 - 5V] DC.
* Provision to control the firing angle through external [4 - 20mA](optional)

Suggested Experiments

1. Single phase half controlled converter
2. Single phase fully controlled converter.
3. Single phase AC regulator.

4. Single Phase Bridge Firing Circuit with PI (PEC14M14 - PI)

* Line synchronized IC based linear firing circuit for SCR applications.
* Line synchronization achieved by 230 / 9V step down transformer.
* Four No's firing pulses to trigger four SCRs.
* 1:1:1 Pulse transformer used for gate pulse isolation.
* One no potentiometer used to vary the firing angle (180° - 0°).
* All four pulses terminated on the front panel for external SCR device module interface.
* Carrier logic circuit implemented for SCR self start, carrier frequency 4KHz.
* Debounce logic circuit implemented for SCR gate pulse ON/OFF.
* One No. toggle switch for gate pulse ON/OFF.
* 230V, 50Hz AC input, fuse provided for over load protection.
* One No. ON/OFF switch with LED indication for power ON/OFF.

* Provision to control the firing angle through external 0 to 5V DC.
* One No. op-amp based analog PI control circuit for closed loop operation.
* Provision to connect feed back signals to PI control circuit.

Suggested Experiments

1. Single phase half controlled converter.
2. Single phase fully controlled converter.

5. Chopper Firing Module (PEC14M16)

* Consists of two no firing pulse to trigger auxiliary, main SCR.
* Two No's 1:1 pulse transformer used for gate pulse isolation.
* One No's potentiometer used to vary the duty -cycle ratio of PWM signal (10 - 90%).
* Debounce logic circuit implemented for pulse ON/OFF.
* Two No's toggle switch for ON/OFF auxiliary, main SCR pulses.
* Necessary test points for triggering circuit study.
* Auxiliary and main SCR pulses are terminated on the front panel to interface with SCR device module. (PEC14M15) & LC module.
* 230V AC, 50Hz AC input. +15 / -15V DC for control circuit.
* Illuminated rocker switch with fuse protection for mains ON/OFF .

Suggested Experiments

1. Auxiliary SCR commutated chopper.
2. Complementary SCR commutated chopper.
3. Jones chopper.
4. Current commutated chopper.
5. Speed control of PMDC motor (motor optional).

6. Cyclo Converter Firing Module (PEC14M17)

* Line synchronized IC based firing circuit for phase control.
* Line synchronization achieved by step down (12 - 0 - 12V) transformer.
* Provision to vary frequency & phase angle of SCR triggering pulses.
* One no potentiometer used to vary the firing angle (180° - 0°).
* Programmable IC for firing circuit frequency variation.
* Two No's toggle switch to select frequency 50Hz, 50 / 2Hz, 50 / 3Hz, 50 / 4Hz.
* Four No's gate pulse to trigger four SCR. 1:1:1 pulse transformer used for gate pulse isolation.
* All four pulses terminated on the front panel for external device module (PEC14M15) interface.
* Carrier logic circuit implemented, carrier frequency 4KHz.
* Debounce logic circuit implemented for SCR gate pulse ON/OFF.
* One no. toggle switch for SCR gate pulse ON/OFF.

* 230V, 50Hz AC input, fuse provided for over load protection.
* One no. rocker switch with LED indication for power ON/OFF.
* By external interface with device module(PEC14M15) and inductive load (PEC13ACC1) step - down cyclo converter experiment can be performed.

7. Cosine Firing Circuit for SCR Converter (PEC14M18)

* Line synchronized IC based cosine wave crossing firing circuit.
* Line synchronization achieved by step - down transformer.
* Op-amp based integrator circuit for cosine wave generator.
* Four No's gate pulse to trigger four SCR. 1:1:1 pulse transformer used for pulse isolation.
* One No. potentiometer used to vary the firing angle (180° - 0°).
* All four pulses terminated on the front panel for external device module (PEC14M15) interface.
* Carrier logic circuit implemented for SCR self - starting. Carrier frequency 4KHz.
* Debounce logic circuit implemented for SCR gate pulse ON/OFF.
* One no . toggle switch provided for SCR gate pulse ON/OFF.
* 230V, 50Hz AC input, fuse provided for over load protection.
* One No. rocker switch with LED indication for power ON/OFF.

Suggested Experiments

1. Single phase half controlled converter.
2. Single phase fully controlled converter.
3. Single phase AC regulator.

8. Microprocessor Based Single Phase SCR Triggering Circuit Trainer (PEC18MP1)

* This trainer consists of (1) 8085 microprocessor kit , (2) SCR firing pulse interface chord with SCR device module. (PEC18MP1)

Microprocessor Trainer

* 8085 Microprocessor (Micro - 85ebII).
* 8KB RAM, 8KB - EPROM. One 8255 port to provide 24 TTL I / O lines.
* 21 Keys multifunction key board with double short characters for long life.
* 6 Digit 7 segment display.

SCR Firing Pulse Interface Chord (PEC18MP1)

* One no.of line synchronized ZCD generator. 230V/9V step down transformer used for line synchronization.
* One no. of 26 pin header to interface microprocessor kit.
* Two no's of pulse amplifier with pulse isolation circuits.
* Two No's of 1:1 pulse transformer provided for gate pulse isolation.
* All four pulses terminated in the PCB for SCR interface with

* Four No's of TYN612 SCR with snubber circuit provided for power circuit.
* All A,K,G terminals are terminated for external power circuit configuration.
* One no.of 230V / 24V AC, 2Amp provided for SCR power circuit input.
* One no. of fixed resistor / lamp used as a load.

Suggested Experiments

1. Single phase half / fully controlled converter with R & L load,
2. Single phase AC regulator with R & L load.

9. Microprocessor Based Three Phase SCR Triggering Circuit Trainer (PEC18MP2)

This trainer consists of (1) 8085 microprocessor kit, (2) SCR firing pulse interface chord with SCR device module. (PEC18MP2).

Microprocessor Trainer

* 8085 Microprocessor (Micro - 85ebII)
* 8 KB RAM, 8KB - EPROM. One 8255 port to provide 24 TTL I/O lines.
* 21 Keys multifunction key board with double short characters for long life.
* 6 Digit 7 segment display.

SCR Firing Pulse Interface Chord (PEC18MP2)

* Three No's of line synchronized ZCD generator . 230V / 9V, Three phase step down transformer used for line synchronization.
* One No's of 26 pin header to interface microprocessor kit.
* Six No's of pulse amplifier with pulse isolation circuits.
* Six No's of 1:1 pulse transformer provided for gate pulse isolation.
* All six pulses terminated in the PCB for SCR interface with ON/OFF switch.

SCR Power Circuit (PEC14HV#P)

* Six No's of TYN612 SCR with snubber circuit provided for power circuit.
* All A,K,G terminals are terminated for external power circuit configuration.
* One no. three phase 230V / 24V AC, 2Amp transformer provided for SCR power circuit input.

Suggested Experiments

1. Three phase fully controlled converter with Lamp load
2. Three phase AC regulator with R & L load

10. SCR Triggering Circuit Trainer (PEC14M12E)

This setup consists of the following basic firing circuits to trigger SCR.

a. R, RC, Triggering circuits,
b. Basic DC Triggering circuit
c. UJT Triggering circuit
d. Micro controller based triggering circuit

a. R, RC Triggering circuit

* One no. of resistor and one no. of capacitor forms R, RC firing circuit
* Potentiometer used for firing angle variation
* Output terminated by connectors.
* Necessary test points provided

b. Basic DC Triggering circuit

* Variable DC power supply with protection.
* One potentiometer used to vary the DC voltage as well as the firing angle.
* Necessary test points provided

c. UJT Triggering Circuit

* One no. of 2N2646 UJT used for firing pulse generation.
* Variable R & C provided for triggering circuits
* Potentiometer provided for firing angle variation.
* Pulse transformer provided for pulse isolation
* 4 Nos. of triggering pulses terminated by suitable connectors.
* Necessary test points.

d. Microcontroller based Firing circuit

* dsPIC30F4011 based firing pulse generation
* One no. of pulse output with firing angle variation (0-180°)
* One no. of digital key provided for firing angle variation.

e. SCR Module

* One no. of SCR with snubber and heat sink provided
* Fixed R Load.
* 24V/1A AC Source provided for power circuit input

B. TYPES OF POWER MODULE

1. SCR, TRIAC, DIAC Device Module (PEC14M15)

* It is a common device module, by interface with external firing module it can be used for different applications.
* Four No's TYN1225 SCR with fuse protection. A,K,G terminals of all SCR terminated individually for external connection.
* Four No's diode with fuse protection A,K of all diode terminals terminated individually for external connection.
* One no . BTA12 TRIAC with fuse protection. MT1,MT2,G terminals are terminated individually for external connection.
* One no. DIAC with fuse protection. MT1,MT2 terminals are terminated for external connection.
* 24VDC / 2A unregulated power supply for device DC operation.
* One no. fuse provided for DC power supply over current protection.
* One no. toggle switch for ON/OFF 24VDC supply.
* Snubber circuit provided for all power devices.
* Low voltage isolation transformer provided for power circuit input
  Input : 230V AC , 50HZ
  Output : 24 - 0 - 24V AC, 3AMP.

Suggested Experiments

1. Line commutated converter / regulator applications.
2. Inverter applications.
3. DC chopper applications.

2. L-C MODULE (PEC14M5A)

* Inductance : 120 µH @ 4 Amp
* Air core inductor with six tappings.
* Each tapping is percentage of 120mH (0%, 10%, 20%, 30%, 50%, 75%, 90%, 100%)
* Combination of commutation capacitors.
* Used for various commutation circuits in chopper circuit.
* Housed in a box with sockets termination for all inductors and capacitors tappings.

3. SCR Module (VPET-106S)

* It consist of one number of SCR (metal package) with heatsink is provided. SCR rating is 1200v /50Amps.
* SCR with heatsink is fixed on a open wooden box with G,A,K terminals are brought out by banana socket.
* RC snubber circuit and fuse are provided

4. TRIAC Module (VPET-106T)

* It consist of one number of TRIAC (metal package)with heatsink is provided.
* TRIAC BTA12 with sating of 600V, 12A
* TRIAC with heatsink is fixed on a open wooden box with G, MT1, MT2 terminals are brought out by banana socket.
* RC snubber circuit and fuse are provided.

5. DIODE Module (VPET-106D)

* It consist of one number of diode (metal package)with heatsink is provided . Diode rating is 1200v /50Amps.
* Diode with heatsink is fixed on a open wooden box with A,K terminals are brought out by banana socket.
* RC snubber circuit and fuse are provided.

III. LOW VOLTAGE SCR APPLICATION TRAINER

1. Single Phase AC Voltage Controller Using SCR and TRIAC (PEC14M14AC)

* Line synchronized IC based linear firing circuit for TRIAC.& SCR
* Line synchronization achieved by 230 / 9V step - down transformer.
* Firing pulse to trigger TRIAC.& SCR
* 1:1 Pulse transformer used for TRIAC & SCR gate pulse isolation.
* One No. potentiometer used to vary the firing angle (180° - 0°)
* Provision to control the firing angle through external [0 -5V] (optional).
* Carrier logic circuit implemented, carrier frequency 4KHz.
* Debounce logic circuit implemented for gate pulse ON/OFF.
* One No. toggle switch for gate pulse ON/OFF.
* One No . TRIAC & two SCR'S with snubber & fuse for AC regulator power circuit.
* 24V AC, lamp with ON/OFF switch for power circuit input.
* One o . fixed R and L used as load for power circuit.
* 230V, 50Hz AC input, fuse provided for over load protection.
* One no. rocker switch for power ON/OFF.

Suggested Experiments

1. Single phase AC regulator using TRIAC with R and RL load.
2. Single phase AC regulator using SCR.

2. Single Phase SCR Half Controlled Bridge Converter (PEC14M14HW)

* Consists of firing circuit, SCR power circuit and load.
* Line synchronized IC based linear firing circuit for SCR.
* Line synchronization achieved by 230 / 9V step - down transformer.
* Four no . firing pulse to trigger SCR.
* 1:1 Pulse transformer used for SCR gate pulse isolation.
* One no. potentiometer used to vary the firing angle (180 - 0d).
* Carrier logic implemented, carrier frequency 4KHz.
* One no. toggle switch with debounce logic for pulse ON/OFF.
* Provision to control the firing angle through external [0 - 5V].
* Power circuit consists of two No's SCR and two power diode with fuse protection.
* Anode, Cathode, Gate terminals are terminated in the front panel for user connection.
* 24V AC, 1AMP provided for power circuit input with ON/OFF switch.
* One no. fixed R,L load provided.
* 230V, 50Hz AC input with ON/OFF rocker switch, fuse for over load.

Suggested Experiments

1. Single phase half controlled converter with R and R - L load.

3. Single Phase SCR Fully Controlled Bridge Converter (PEC14M14FW)

* Consists of firing circuit, SCR power circuit and load.
* Line synchronized IC based linear firing circuit.
* Line synchronization achieved by step - down transformer.
* Four no. firing pulses to trigger four SCRs.
* 1:1:1 Pulse transformer used for pulse isolation.
* One No . potentiometer used to vary the firing angle (180° - 0°).
* Carrier logic implemented, carrier frequency 4KHz.
* One no. toggle switch with debouncing logic for pulse ON/OFF.
* Provision to control the firing angle through external [0 - 5V].
* Power circuit consists of four no. SCR with fuse protection.
* Anode, Cathode, Gate terminals are terminated in the front panel for user connection.
* 24V AC, 1AMP provided for power circuit input with ON/OFF switch.
* One no. fixed R, L load provided.
* 230V, 50Hz AC input with ON/OFF rocker switch, fuse for over load.

Suggested Experiments

1. Single phase fully controlled converter with R and R - L load.

4. Forced Communication Circuits (Class A,B,C,D&E) Communication (Chopper) Circuit Module PEC14M14CH.

* Consists of firing circuit, SCR power circuit and load.
* IC based firing circuit to trigger two SCRs.
* One no. potentiometer used to vary the frequency of firing pulse.
* One potentiometer used to vary the duty cycle ratio of PWM.
* Two no. toggle switch with debounce logic for ON/OFF pulses.
* Pulse transformer used for gate pulse isolation.
* Two No's SCR and one no diode provided with A,K,G terminals are terminated on front panel for external connection.
* Two No's fixed R load. Two No's capacitor and one no fixed inductor for commutation circuit.
* Separate firing pulse section for line commutation circuit and external pulse commutation circuit.
* 15V DC, 1AMP for SCR power circuit input and 9V AC for SCR line commutation circuit input.
* Two no. toggle switch for ON/OFF DC and AC voltage.

Suggested Experiments

1. Load commutation circuit (class - A).
2. Resonant pulse commutation circuit (class-B).

3. Complementary commutation circuitry (class-C).
4. Impulse / auxiliary commutation circuit (class-D).
5. External pulse commutation circuit (class-E).
6. Line / natural commutation circuit (class- F)

5. SCR BASED DC CHOPPER CIRCUIT (PEC14M14CH#1)

* Consists of firing circuit, power circuit and load.
* Firing circuit :
* IC Based square wave generation.
* Two No's firing pulse to trigger auxiliary and main SCR.
* One potentiometer used to vary the frequency of the firing pulse (100Hz - 300Hz, Approx)
* One No's potentiometer used to vary duty cycle ratio. (10% - 90%).
* Two No's toggle switch to ON/OFF SCR gate pulses.
* Necessary test points to measure control circuit waveform in CRO.
* Power circuit :
* Two No's TYN612 SCR with heatsink, snubber circuit & two No's power diode provided for power circuit.
* One no. center tapped inductor, capacitor used for commutation circuits.
* LM723 Based 24V DC, 2AMP DC power supply with S/C,O/C protection for chopper power circuit input voltage.
* One no. toggle switch for 24V DC ON/OFF, with LED indication.

Suggested Experiments

1. Class B SCR commutated chopper.
2. Class D SCR commutated chopper.

6. Single Phase Cyclo Converter (PEC14M14CY)

* Consists of firing circuit, SCR power circuit and load.
* Line synchronized IC based linear firing circuit.
* Line synchronization achieved by step - down transformer.
* Four No's firing pulse with pulse transformer isolation to trigger four SCR.
* One no. potentiometer used to vary the firing angle (180° - 0°).
* Carrier logic implemented, carrier frequency 4KHz.
* One no. toggle switch with debounce logic for pulse ON/OFF.
* EPROM Based firing pulse frequency variation.
* Two No's. toggle switch to select different frequency (50, 50 / 2, 50 / 3, 50 / 4 Hz).
* Power circuit consists of four No. SCR with fuse protection.
* Anode, Cathode, Gate terminals are terminated in the front panel for user connection.

* 24V AC, 1AMP Provided for power circuit input with ON/OFF switch.
* One no. fixed R, load provided. Center tapped inductor for power circuit.
* 230V, 50Hz AC input with ON/OFF rocker switch, fuse for over load.

Suggested Experiments

1. Single phase cyclo converter with different output frequency with the different voltage**.**

7. Single Phase SCR Full Bridge Inverter (PEC14M14#INV)

* Consists of SCR power circuit and firing circuit.
* 4046 IC based square wave generation with adjustable frequency.
* One no. potentiometer used to vary the frequency (10 - 100Hz).
* 1:1 Pulse transformer used for gate pulse isolation.
* Pulse output terminated in the front panel for user patching.
* Power circuit consists of four No's SCR (TNY612), four no diodes.
* Two No's center tapped inductor and capacitors provided for power circuit commutation.
* LM 723 Based 24V / 2A DC power supply with LED indication.
* One no. toggle switch used to ON/OFF 24V DC power supply.
* Over load and short circuit protection provided for DC power supply.
* 230V, 50Hz AC input, +15V DC / 1AMP for control circuit.
* One no. fuse provided for power supply protection, necessary test points provided.

Suggested Experiments

1. Study of inverter firing circuit.
2. Testing of SCR inverter with R load with frequency variation.

8. SCR Series Inverter (PEC14M6)

* Consists of SCR power circuit and firing circuit.
* IC Based firing pulse generation to trigger SCR.
* One no. pot used to vary the frequency of firing pulse (300 - 600Hz).
* One no. toggle switch to ON/OFF SCR gate pulses.
* 1:1 Pulse transformer used for gate pulse isolation.
* Pulse output terminated in the PCB for user patching.
* Power circuit consists of two No's SCR (TYN612), center tapped inductor center tapped capacitor.
* LM 723 Based 24V / 2A DC power supply with LED indication.
* One no. toggle switch used to ON/OFF 24V DC power supply.
* Over load and short circuit protection of input DC.
* 230V, 50Hz AC input , +15V DC / 1AMP for control circuit.

* One no. output PI - filter to filter series inverter output voltage.
* One no. fuse provided for power supply protection, necessary test points provided.

Suggested Experiments

1. Study of series inverter firing circuit.
2. Testing of series inverter with R load with frequency variation.

9. SCR Parallel Inverter (PEC14M7)

* Consists of SCR power circuit and firing circuit.
* 4046 IC Based square wave generation with adjustable frequency.
* One no. potentiometer used to vary the frequency (50 - 100Hz).
* 1:1 Pulse transformer used for gate pulse isolation.
* Pulse output terminated in the PCB for user patching.
* Power circuit consists of two No's SCR (TNY612), inverter transformer with flay back winding.
* One no. Iron core inductor provided for power circuit.
* One no. AC capacitor for SCR commutation.
* LM 723 Based 24V / 2A DC power supply with LED indication.
* One no. toggle switch used to ON/OFF 24V DC power supply.
* Over load and short circuit protection provided for DC power supply.
* 230V, 50Hz AC input, +15V DC / 1AMP for control circuit.
* One no. fuse provided for power supply protection, necessary test points provided.

Suggested Experiments

1. Study of parallel inverter firing circuit.
2. Testing of parallel inverter with R load with frequency variation.

10. Morgans Chopper Circuit Trainer (PEC14M20)

This trainer is designed to implement and demonstrate Morgan chopper circuit. It can be used for speed control of PMDC motor using Morgan chopper.

* Single SCR with snubber circuit and one diode is provided
* Capacitor and inductor is provided for commutation
* 24V DC/3 Amp Power supply is provided for chopper input
* ±15V / 1Amp for internal control circuit
* Isolation is provided for gate pulse.

11. Jones Chopper Trainer Module (PEC14M21)

* Two nos. SCR with RC supper provision
* Two nos. Diodes and one fixed load resistor.
* One center tapped (0%, 50%, 100%) inductor (120mh) for power circuit with one commutating capacitor.
* Two isolated firing pulses to fire SCR
* Two nos. Toggle switches to switch ON Auxiliary SCR pulse and main SCR pulse.
* One 24V/1A Fixed DC Supply for power circuit and one toggle switch to ON/OFF DC supply.
* All input and outputs of Power circuit components (SCR DIODE, LOAD) are terminated in a PCB for student patching.
* Necessary test points for study of firing circuit.
* One Potentiometer for Duty cycle variation.

12. UJT Firing Circuit for SCR Converter (PEC14M12B)

* Consists of UJT firing circuit and SCR power circuit and load.
* Line synchronized UJT firing circuit. Line synchronization achieved by 230 / 9V step - down transformer.
* Built in 24V AC, 1AMP for UJT firing circuit input.

* One no. potentiometer used to vary the firing angle (180° - 0°).
* Two No. 1:1 pulse transformer provided for gate pulse isolation.
* All four gate pulses are terminated in the PCB with suitable connector.
* Four No. TYN612 SCR with snubber circuit for power circuit.
* All SCR A,K,G terminals are terminated individually for external configuration.
* 230V / 24V, 2AMP transformer provided for power circuit input voltage.
* One no. toggle switch to ON / OFF 24V AC.
* One no. fixed resistor one no fixed inductor provided for load.

Suggested Experiments

1. Study of UJT firing circuit.
2. Testing of single phase half wave controlled converter.

13. Controlled HWR and FWR Using RC Firing (PEC14M12C)

Two separate sections are provided.

a. Half wave rectifier
b. Full Wave rectifier

a. Half Wave rectifier

* One No. of SCR rated at 600V, 12A is provided
* R, C Based firing
* Lamp load is provided
* One potentiometer is used to vary the firing angle of SCR.
* 230V/24V operation

b. Full Wave Rectifier

* One no. SCR rated at 600V, 12A is provided
* 4 Nos. of Diode is used
* R, C Based firing
* One potentiometer is used to vary the firing angle of SCR.
* 230V/24V operation

IV. HIGH VOLTAGE SCR APPLICATION TRAINER

1. Single Phase (Half & Fully) Controlled Bridge Converter (PEC14HV4)

* Specially designed for high voltage operation. It consists of firing module, SCR power circuit and high voltage accessories (optional).

a. Firing Module

* vdspic4011 Micro controller based linear triggering circuit.
* Touch keys to select and vary the firing angle (0° - 180°).
* Line synchronization achieved by step - down transformers and ZCD generator circuit.
* Carrier logic implemented for SCR self - starting. One no. Toggle switch with debounce logic for pulse ON/OFF.
* Pulse output terminated in the front panel for device module interface.
* Speed sensor interface provision for motor control operation

b. SCR Power Circuit

* Power circuit consists of two no. SCR (SKKT92B16E) rating at 1200V, 90AMP two No's power diode rating at 1200V, 50AMP).
* All terminals of diode and SCRs terminated on the front panel for external connection.
* One no. MCB provided for mains. Fuse provided in input side.
* 1 : 1 pulse transformers and amplifiers used for gate pulse isolation and amplifications
* Test points to view the signals at each levels.

c. Suggested Experiments

1. Single phase half and fully controlled converter with R and RL load.
2. Single phase AC regulator with R and RL load.

2. Three Phase (Half & Fully) Controlled Bridge Converter (PEC14HV5)

* Specially designed for high voltage operation. It consists of three phase firing module, SCR three phase power circuit and high voltage accessories (optional).

a. Firing Module

* Micro controller based based three phase linear triggering circuit.
* Touch keys used to vary the triggering angle (0° - 180°).
* Line synchronization achieved but three phase step-down transformer and ZCD generator circuit.
* Carrier logic implemented for SCR self - starting. One No. Toggle switch with debounce logic for pulse ON/OFF.
* All six pulses output terminated in the front panel for device module interface.
* Speed sensor interface provision for motor control operation

b. SCR Power Circuit

* Power circuit consists of six No. SCR (SKKT92B16E) rating at 1200V, 90 AMP two no. power diode rating at 1200V, 50AMP).
* All terminals of diode and SCRs terminated on the front panel for external connection.
* One No. 3 Pole MCB provided to ON/OFF input three phase AC.
* 1:1 pulse transformers and amplifiers used for gate pulse isolation and amplifications
* Test points to view the signals at each levels.
* Indicator and fuse provided for mains R,Y,B.

c. Suggested Experiments

1. Three phase half and fully controlled converter with R and RL load. (optional)
2. Three phase AC regulator with R and RL load. (load optional).

3. Single Phase Dual Converter (PEC20M1 & 20M2)

a. Firing Module

* 8 nos. pulses for `P' group and `N' group SCR converter.
* 1 No. of ZCD Generator circuits with test points is provided to give reference signals.
* Touch keys to select and vary the firing angle.
* One pulse ON/OFF switch and power ON/OFF switch is provided
* Necessary test points provided for waveform study
* +5V DC & 9V AC for control circuit
* LCD Display is provided
* All components are housed in a fine powder coated cabinet

b. Power Circuit

* 8 Nos. of SCR's with snubber protection is provided for `P',`N' group converters.
* All `G', `K' terminals are terminated in front panel for waveform study
* 15 pin shielded cable for pulse input from the controller to power circuit.
* Two Nos.of step down transformer for power circuit input AC voltage
* One Center tapped inductor (0%,50%,100%) for power circuit with circulating current mode (Optional)
* All components are housed in a fine cabinet
* Provision for Speed sensor sensing arrangement for motor application
* Two Nos of MCB provided with fuse to isolate the input AC supply

c. Suggested Experiments

* Study of Single phase dual converter with and without circulating current mode.

4. Three Phase Dual Converter (PEC20M3 & 20M4)

a. Firing Module

* 12 Nos pulse for 'P' Group and 'N' Group SCR Converter
* Touch keeps to select and vary the firing angle.
* 1 No of Pulse ON / OFF switch and power ON / OFF switch is provided
* Necessary test point provided for waveform study
* Feedback connector provision for motor load
* LCD Display is provided

b. Power Circuit

* 6 Nos of SCR provided for snubber protection is provided for 'P' Group and 'N' Group Converters
* All 'G' and 'K' Terminals are terminated in front panel for waveform study
* 15 pin shielded cable for pulse input from the controller to power circuit
* Two nos of three phase step down transformers is provided for power circuit input
* One No. of center tapped inductor for 1GR purpose
* Supply is terminated to power circuit via three pole MCB and fuse of proper value

5. Thyristor Chopper for SCR DC Drive (PEC14HV7)

* Consists of SCR power circuit and firing circuit.
* IC Based firing pulse generation to trigger auxiliary and main SCR.
* Pulse transformer provided for gate pulse isolation.
* One potentiometer used to vary the duty cycle ratio of PWM (10 - 90%).
* Two no. toggle switch with debounce logic for ON/OFF gate pulse.

* Power circuit consists of two no's TYN1225 SCR, diode forms auxiliary SCR commutation circuit.
* Fixed L - C provided for power circuit commutation.
* One no. diode bridge converter with filter capacitor convert input 230V AC to DC for power circuit input.
* MCB Provided for input AC ON/OFF, over current protection.
* One no. diode converter provided for field circuit (DC motor control experiment optional).
* 230V, 50Hz Input . Built in +15, -15V DC for control circuit.
* Provision to control the duty cycle ratio from external source voltage [0 - 5V].
* Power ON/OFF switch, necessary test points for firing circuits.

Suggested Experiments

1. High voltage auxiliary SCR commutated chopper with R, RL load
2. Speed control of DC shunt motor using SCR chopper.

6. Single Phase Parallel Inverter (High Voltage) [PEC14M7HV]

* Input : 24V DC, 2Amp
* Output Voltage : a. 230V AC, 50VA
  b. 24V AC, 50VA
* Output Frequency : 50Hz to 100Hz (Variable)

It consists of 3 separate sections which is as follows.

a. Parallel Inverter firing circuit
b. SCR power circuit
c. 24V DC Source.

a. Parallel Inverter Firing Circuit

* 4046 VCO Based square wave generation with adjustable frequency (50 to 100Hz).
* Square wave modified into short pulses by control ICs.
* Two nos of 1:1 Pulse transformer provided for pulse Isolation.
* Pulses imposed with high frequency square (4KHz) for SCR self start
* 7 Nos. of test points provided for signal test/measure purpose

b. Power Circuit

* It consists of two nos. of SCRs rating at 600V, 12A with heat sink is provided
* Two nos. of power diode provided.
* One no. of output transformer is provided.
  # Input : 24V (with 5 tappings)
  # Output : 230V, 24V
* One no. of Iron core Inductor is provided (100mH, 1Amp)
* One no.fuse is provided for over load protection
* One no. AC Capacitor provided for SCR commutation

c. 24V DC Source

* It consists of LM723 based voltage regulator provided for DC input to SCR power circuit
* Rating : 24V DC, 2 Amps.
* One no. of toggle switch provided for DC ON/OFF
* One LED Indication
* Current fold back facility provided for output Over current/Short circuit

Documentation Support

* One no. of technical / User manual with circuit diagram

Suggested Experiments

1. Study of Parallel inverter firing circuit
2. Study of SCR parallel inverter with different frequency
3. Calculation of SCR turn ON/OFF time of SCR parallel inverter

Protection

* Output Over Load or short circuit protection

Input

* 230V AC ± 5%, 50Hz operation.

7. Three Phase Parallel Inverter (PEC14M7HV1)

This trainer is designed to study the working principle of three phase parallel inverter. This set up consists of,

a. Three phase parallel inverter firing circuit
b. Parallel inverter power circuit
c. LM723 based 23V DC source.

a. Three phase Parallel Inverter Firing Circuit

* IC Based 3ϕ square wave generation with 120° phase shift with frequency variation.
* One number of potentiometer provided for frequency adjustment (20-60Hz)
* Six numbers of pulse transformer provided for SCR gate pulse isolation
* Gate carrier logic implemented for SCR gate pulses.
* One number of toggle switch with debounce logic provided for all six pulse ON/OFF.
* All pulses are terminated in the front panel for SCR patching
* Necessary test points provided on the control circuit for waveform measurement.

b. Parallel inverter Power Circuit

* Six number of TYN 1225 SCR with suitable heat-sink, snubber circuit provided for power circuit.
* Six number of power diode provided for fly-back operation.
* Three number of ac capacitor provided for SCR commutation
* One number of three phase 24-24-0-24/24.0-24V,3Amp transformer provided for parallel inverter power circuit
* Necessary terminals of SCR, diode, transformer are terminated in the panel for wiring.

c. LM723 based 24V DC Source for parallel inverter input

* LM723 based 24V power supply provided for parallel inverter input.
* 3 Amp Capacity.
* Overload, short circuit protection facility
* LED provided for DC indication.

8. Single Phase Series Inverter (High Voltage) (PEC14M6HV)

This module is designed to demonstrate the working principle of Thyristorised Series Inverter.

Main Circuit

* 2 SCRs : Rating : 600V @ 12Amp
* A Potentiometer is provided to vary the load power.
* Snubber circuit is provided to each devices.
* Circuits for commutation triggering SCRs are provided.

Power Supply

Input 230V ±10%, 50Hz single phase AC
24 Volt DC @ 2 Amp to feed inverter.
±15V DC @ 0.5A regulated output for the trigger circuits.

9. Single Phase Cyclo Converter (High Voltage) PEC14HV9

This module is designed for center tap transformer Cyclo Converter.

It consists of 4 synchronized firing pulses, 4 SCRs, Relevant Power supply etc, for frequency division of 1,2,3 & 4.

Main Circuit

* 4 SCRs : Rating 1200V @ 25Amp
* 4 Synchronized firing pulses to trigger SCRs
* Digital firing for frequency division of 1,2,3 & 4.

Power Supply

* Input 230V ±10%, 50Hz single phase AC
* ±15V DC @ 0.5A regulated output for the trigger circuits.
* Center tape Transformer.

Output

* 0-230Volt AC
* Frequency : 50/2 HZ,50/3 HZ&50/4 HZ.
* The output can be loaded with R,L or AC MOTOR (0.5hp).

Suggested Experiments

1. Study of Speed control of AC motor using Cyclo Convertor.

10. Single Phase Mc-murray-bed Ford Full Bridge Inverter (VPET-111A)

* Four isolated gate pulses are provided to fire the Four number of SCRs.
* One Potentiometer provided to vary the frequency of the inverter from 10Hz - 50 Hz
* One Potentiometer provided to vary the frequency of the inverter
* All gate pulses are Isolated by pulse isolation transformer
* Four SCRs rated 1200V/25A provided
* Two Diodes rated 1200V/6A provided
* 4 Nos. of Commutating capacitors and 1 No. of center tapped inductors (Rating at 120mH, 4A) provided.
* All SCRs, Diodes, Capacitors & Inductors forms Single phase inverter with 180° mode conduction
* DC Input of inverter fed from three phase SCR converter

11. Three Phase Mc-murray-bed Ford Full Bridge Inverter (VPET-111)

* Six isolated gate pulses are provided to fire the six number of SCRs.
* One Potentiometer provided to vary the frequency of the inverter from 10Hz - 50 Hz
* One Potentiometer provided to vary the frequency of the inverter
* All gate pulses are Isolated by pulse isolation transformer
* Six SCRs rated 1200V/25A provided
* Six Diodes rated 1200V/6A provided
* 6 Nos. of Commutating capacitors and 3 Nos. of center tapped inductors (Rating at 120mH, 4A) provided.
* All 6 Nos. of SCRs, Diodes, Capacitors & Inductors forms 3 phase inverter with 180° mode conduction
* DC Input of inverter fed from three phase SCR converter**.**

12. Three Phase Cyclo Converter (PEC14HV11)

* This module is designed for three phase half wave-step down cycloconverter.
* It consists of 18 Synchronized firing pulses, 18 SCRs, Relevant power supply and circuitry for frequency divisions.

Main Circuit

* 18 Nos SCR with RC snubber protection is provided for 3ϕ cycloconverter power circuit (each phase consist of 6 SCRs) Rated at 1200 V @ 25 Amps.
* 3 Nos center tapped inductor (0%. 50%, 100%) is provided for power circuit.
* 18 Nos isolated gate pulses for SCR power circuit.
* One potentiometer is provided to vary the frequency.
* One potentiometer is provided to vary the output voltage.
* MCB protection.
* Housed in sleek screen printer cabinet.
* Provision for V/F control

Power Supply

* Input 440V ± 10%, 50Hz three phase AC supply.
* ± 15V DC, 9V, 9V,9V AC(3ϕ) for the firing circuits.

Output Ranges

* Frequency Variation : 1 Hz to 1/3 rd of supply frequency (Approx : 1 Hz to 16Hz)
* Voltage Variation : 0 to 90% of supply voltage.

13. Three Phase Diode Characteristics Trainer(PEC14HV5D)

* It consists of 6 Nos. of power diode rating at 1200V, 25Amps
* All diodes A,K terminals are terminated individually for different configuration.
* Fuse provided for protection
* MCB Provision for 3ϕ ON/OFF.
* Three phase step down transformer provided for low voltage operation.
  # Input : 230V,230V,230V,3ϕ
  # Output : 24,24,24,3ϕ, 3Amps.
* 4 Nos. of Hall effect current sensor provided to measure input current and output current.
* One no. of hall effect voltage sensor provided to measure the output voltage

Suggested Experiments

1. 3ϕ Half wave rectifier Common Cathode arrangement with R Load
2. 3ϕ Half wave rectifier Common Anode arrangement with R Load
3. 3ϕ Bridge rectifier with R Load.

V. SCR BASED AC/DC DRIVES

1. DC Motor Speed Control Trainer (PEC04)

Firing Module

* Vdspic4011 Microcontroller based firing circuit using reference ZCD.
* Firing angle and other selections using five no of feather touch keys.
* Pulse enable switch is provided.
* For motor control experiments speed feedback provision is available.
* LCD is provided to view the data of speed, firing angle etc.,.
* Test points are provided to view pulses and ZCD
* Pulse termination on ‘D’ socket.

Power Module

* This trainer is designed to drive the 1HP DC motor (optional) both open loop and closed loop.
* Armature and field pulse control facility is provided.
* It consists of SCR based fully controlled converter for armature voltage variation.
* One no. of fixed field supply is provided

Suggested Experiments

1. Open loop armature control of DC shunt motor.
2. Closed loop armature control of DC shunt motor (speed / current feedback)
3. Field control of DC shunt motor.

2. Speed Control of Single Phase Induction Motor (PEC14HV4C)

* This trainer is designed to drive the single phase AC induction motor or universal motor using SCR based V / F controller. (open / closed loop).
* SCR Based single phase converter and inverter forms V / F controller.
* Variable voltage achieved by controlling the firing angle of SCR converter. Variable frequency achieved by controlling the firing pulse frequency of SCR Mc-Murray inverter.

SCR Converter and Firing Circuit

* Op-amp based linear firing circuit gives 0° - 180°d firing angle variation.
* One no. potentiometer used to vary the firing angle adjustment.
* All four pulses isolated by pulse transformer and terminated in the front panel.
* Four No's TYN1225 SCR forms single phase fully controlled converter with LC Filter gives 300V DC to SCR inverter.
* MCB and fuse (DC side) provided for over current protection.

SCR Mc-Murray Inverter and Firing Circuit

* IC based firing circuit with variable frequency (10 - 50Hz).
* [0 - 5V] DC adjust the firing angle frequency. Four No's Firing pulse with pulse transformer isolation terminated in the front panel.
* Four No's TYN612 SCR and four No's diode forms power circuit. Four no. Capacitor and two No's Center tapped inductor for commutation.
* Separate control circuits for adjusting V / F ratio. Provision to control the V / F ratio in external [0 - 5V] DC (closed loop)
* Input : 230V AC
* Output : [0 - 230V] variable AC and [10-50Hz] variable frequency
* Current : 7.5Amp

3. Speed Control of Three Phase Induction Motor Controller Using SCR Inverter (PEC14HV5C)

* This trainer is designed to drive the three phase AC induction motor using SCR based V/F controller. (open / closed loop).
* SCR based three phase converter and inverter forms V / F controller.
* Variable voltage achieved by controlling the firing angle of SCR converter. Variable frequency achieved by controlling the firing pulse frequency of SCR Mc-Murray inverter.

SCR Converter and Firing Circuit

* Op-amp Based linear firing circuit gives [0°-180°d] firing angle variation.
* One no. potentiometer used to vary the firing angle adjustment.
* All six pulses isolated by pulse transformer and terminated in the front panel.
* Six No's TYN1225 SCR forms single phase fully controlled converter with

LC filter gives 600V DC to SCR inverter.

* MCB and fuse (DC side) provided for over current protection. DC voltmeter provided for DC rail voltage measurement.

SCR Mc-Murray Inverter and Firing Circuit

* IC Based three phase firing circuit with variable frequency (10 - 50 Hz).
* [0 - 5V] DC adjust the firing angle frequency. Six No's Firing pulse with pulse transformer isolation terminated in the front panel.
* Six No's TYN612 SCR and six No's diode forms power circuit. six No's capacitor and three No's center tapped inductor for commutation.
* Separate control circuits for adjusting V / F ratio. Provision to control the V / F ratio in external [0 - 50V] DC (closed loop).
* Input : 440V AC 3 phase
* Output : [0 - 415V] variable AC and [10-50 Hz] variable frequency
* Current : 5Amp.

4. Speed Control of DC Shunt Motor using Three Phase Fully Controlled Converter (VPET-301)

This set-up is designed for speed control of dc motor both armature and field control method. Separate PID controller can be used for armature closed operation.

It consists of

a. SCR based three phase fully controlled converter for dc motor armature circuit.
b. SCR based single phase half controlled converter for motor field circuit
c. Digital PID controller for closed loop operation
d. 1 hp 440vdc shunt motor set-up. a. Scr three phase fully controlled converter for armature voltage variation:

* Three number of TCA785 phase control ic provided for three phase scr firing pulse generation.
* One number of potentiometer provided for firing angle variation(180-0degree).
* Three phase step-down transformer provided for supply synchronization.
* Six number of Pulse transformer provided for scr pulse isolation
* One number of Spdt switch provided for pulse on/off.
* All six pulses are terminated on the front panel for power circuit connection.
* Test points provided for wave form measurement.
* Connector provided for external 0-5v control (for closed loop operation)
* One number of spdt switch provided for internal /external mode selection.
* Six number of tyn1225 scr with suitable snubber and heat sink provided for Power circuit.
* All six scr forms three phase fully controlled converter power circuit.
* Power circuit input and outputs are terminated by banana connector on the front panel.
* Three phase mcb provided for input on/off. With indicator
* Input : three phase 415v ac
* Output: 0-550vdc,5amp

b. SCR single phase half controlled converter for field voltage variation:

* One number of TCA785 phase control ic provided for scr firing pulse generation.
* One number of potentiometer provided for firing angle variation(90-20degree).
* Single phase step-down transformer provided for supply synchronization.
* Two number of Pulse transformer provided for scr pulse isolation.
* One number of Spdt switch provided for pulse on/off.
* All two pulses are terminated on the front panel for power circuit connection.
* Test points provided for wave form measurement.
* Two number of tyn1225 scr with suitable snubber and heat sink provided for Power circuit.
* All two scr ans diode forms single phase half controlled converter power circuit.
* Power circuit input and outputs are terminated by banana connector on the front panel.
  Input : Single phase 230v ac
  Output : 100-200vdc,1amp
* Protection circuit: over current protection Field failure protection

c. Digital PID controller for closed operation.

* Intel 8051 Microcontroller based CPU card
* 2 Row x 16 Column LCD Dot Matrix with back light Display Alphanumeric Display
* single Channel Single ended Analog Input Range : (0-5)V DC
* Single Channel Analog Output (0-5) Volt
* One I/V Converter and V/I converter provided
* 4 Number of keys provided to give set point, increment, Decrement function etc.
* In-Built IC regulated power supply
* Provision to change any one of the following,
  Input : (0-5)V
  Output : (0-5)V

d. Motor set-up

* 1hp DC shunt Motor
* Armature voltage-440vdc,2amp
* Field voltage ------220vdc, .5amp
* Speed 1500rpm
* Double side shaft extension
* Speed sensor with speed display and speed feed back(0-5vdc) facility
* Mechanical spring balance load set-up

5. Closed Loop Speed Control of PMDC Motor using SCR Converter (PEC-03A)

Features:

* 180V Permanent Magnetic DC motor is provided
* Line commutated SCR converter to feed the armature Voltage of the DC motor
* Phase angle firing
* A Potentiometer is provided for setting the speed .
* Sensor for speed sensing provided
* A Digital Indicator with 3½ digit LED display for standalone operation (Open Loop) to indicate the speed of the DC motor
* Can Operate in i) Stand alone mode (Only open loop) ii) Microprocessor controlled iii) IBM PC Computer controlled

SPECIFICATIONS

Converter

Single Phase Firing Bridge Circuit

* Four Isolated gate signals for Full Bridge converter
* Firing Angle vary from 180° to 0° through Ramp and pedestal control
* Gated carrier source at 4 KHz.

SCR Circuit

* Four thyristors are provided
* Snubber circuit is provided to each device
* All gate signals are feed through polarized connectors.
* Thyristor power pack used to provide variable field voltage of DC Motor.

Other Features

* One F/V converter provided to convert the pulses of the speed sensor to voltage
* One 3½ digit display provided to display the actual and reference speed.
* Opto coupler is provided for coupling
* Pulse transformer provided for coupling
* Pulse transformer provided to isolate low power and high power sides of the circuitry

Applications

* Study of Thyristor control of DC Motor
* Measure the speed of DC motor
* Display the speed of DC Motor
* Establish an open loop control
* Study of DC variable Speed Drive

6. Speed Control of DC Shunt Motor Using SCR Dual Converter (PEC14HV6A)

* Consists of dual converter firing circuit and SCR power circuit.

Firing Circuit (PEC20M2)

* Two sets of op-amp based linear firing circuits for +ve & -ve group SCRs.
* 8 No's of triggering pulse with 1:1 pulse transformer isolation.
* One No. SPDT with debounce logic for all pulse ON/OFF.
* One no. toggle switch to select circulating/ non circulating current mode operation.
* Two No. potentiometer used for firing angle adjustment in two modes.
* Necessary test points for control circuits.

Dual Converter Power Circuit (PEC20M1)

* Four No. TYN1225 SCR based fully controlled converter for +ve group converter.
* Four no. TYN1225 SCR based fully controlled converter for -ve group converter.
* All SCR gate pulses and necessary terminals are brought out for external connection.
* One no. 120mH center tapped inductor used for IGR.

7. Thyristor DC Chopper (PEC14HV7)

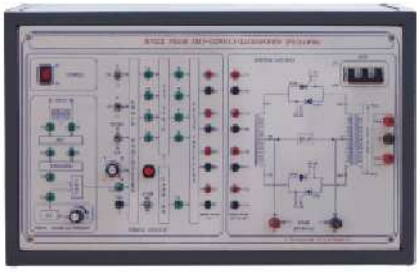
* Consists of SCR power circuit and firing circuit.
* IC Based firing pulse generation to trigger auxiliary and main SCR.
* Pulse transformer provided for gate pulse isolation.
* One potentiometer used to vary the duty cycle ratio of PWM (10 - 90%).
* Two no. toggle switch with debounce logic for ON/OFF gate pulse.
* Power circuit consists of two no's TYN1225 SCR, diode forms auxiliary SCR commutation circuit
* Fixed L - C provided for power circuit commutation.
* One no. diode bridge converter with filter capacitor convert input 230V AC to DC for power circuit input.
* MCB Provided for input AC ON/OFF, over current protection.
* One no. diode converter provided for field circuit (DC motor control experiment optional).
* 230V, 50Hz Input . Built in +15, -15V DC for control circuit.
* Provision to control the duty cycle ratio from external source voltage [0 - 5V].
* Power ON/OFF switch, necessary test points for firing circuits.

Suggested Experiments

1. High voltage auxiliary SCR commutated chopper with R, RL load
2. Speed control of DC shunt motor using SCR chopper.

8. Speed Control of Single Phase Induction Motor Using Cyclo Converter (PEC14HV9)

This module is designed for center tap transformer Cyclo Converter.



It consists of 4 synchronized firing pulses, 4 SCRs, Relevant Power supply etc, for frequency division of 1,2,3 & 4.

Main Circuit

* 4 SCRs : Rating 1200V @ 25Amp
* 4 Synchronized firing pulses to trigger SCRs
* Digital firing for frequency division of 1,2,3 & 4.

Power Supply

* Input 230V ±10%, 50Hz single phase AC
* ±15V DC @ 0.5A regulated output for the trigger circuits.
* Center tape Transformer.

Output

* 0-230Volt AC
* Frequency : 50/2 HZ, 50/3 HZ & 50/4 HZ.
* The output can be loaded with R,L or AC MOTOR (0.5hp).

Suggested Experiments

1. Study of Speed control of AC motor using Cyclo Convertor.

9. Speed Control of Three Phase Slip Ring Induction Motor Using Static Kramer Drive (PEC16HV10B)

This setup designed for open loop speed control of 3 phase Slip Ring induction motor using SCR converter & inverter circuit.

* It consists of three major parts namely,
  # SCR 3 phase inverter
  # SCR 3 phase inverter firing circuit
  # Slip ring induction motor setup with rotor converter circuit & RL For DC filtering

SCR 3 phase Inverter

* It consists of 6 Nos. of SCRs rated at 1200V, 50Ampwith suitable heat sinks to form 3 phase fully controlled converter work as a 3phase inverter ($\alpha > 90°$)

SCR 3 phase inverter firing circuit

* Six Isolated gate signals for Full Bridge Converter.
* Firing Angle variable from 180° to 0°through Ramp and pedestal control.
* Gated carrier source at 4 KHz.
* Housed in a Sleek cabinet.
* Test points are provided on the front panel for detailed study of circuit signals by the student.
* Necessary test points are terminated at sockets so that the student can monitor/ measure/study the signals using CRO, DVM, etc.,
* One potentiometer to vary the firing angle.
* One ON/OFF switch with indicator provided to power the control circuitry so that the students can monitor all the test points of the control circuitry for correct functioning.

Slip ring motor with diode bridge rectifier

* 3 phase 3 hp slip ring induction motor
  - Make : Benn
  - Volts : 400/440V, 3 phase, 50 Hz
  - 2.2 KW (3 hp), RPM : 1440
  - 4.5 Amps
  - Rotor Volts : 210 Volt
  - Rotor Current : 6 Amps
* One no. of 3 phase bridge rectifier is provided to convert rotor circuit volt 13%, 210V to DC
* One no. of 'L' & 'R' provided for DC filtering
* Necessary test points provided for easy study
* Entire control circuit mounted inside a compact box
* Mimic circuit is drawn in the front panel
* Many test points are provided along with front panel
* A Nice text-lab manual is provided
* Power Supply :
  Input:230V ± 10%, 3 phase AC
  ±15V DC @ 0.5A regulated output for the control circuitry.

10. Dc Series Motor Controller Using Jones Chopper (PEC14M21A)

This setup designed for open loop & closed loop speed control of DC Series motor using SCR Jones chopper circuit.

It consists of,

a. SCR Jones chopper firing and power circuit
b. DC Motor setup
c. Digital PI Controller
d. Isolation transformer.

a. SCR Jones chopper firing and power circuit

* Two nos. SCR with RC snapper provision
* Two nos. Diodes and one fixed load resistor
* One center tapped (0%, 50%, 100%) inductor (120mH) for power circuit with one commutating capacitor
* Two isolated firing pulses to fire SCR
* Two nos. Toggle switches to switch ON Auxiliary SCR pulse and main SCR pulse
* One 300V Fixed DC Supply for power circuit and one toggle switch to ON/OFF DC supply
* All input and outputs of Power circuit components (SCR DIODE, LOAD) are terminated in a PCB for student patching
* Necessary test points for study of firing circuit
* One Potentiometer for Duty cycle variation.

b. DC Series Motor

* 1hp
* Armature voltage-220vdc,5amp
* Speed 1500rpm
* Double side shaft extension
* Speed sensor with speed display and speed feed back(0-5vdc) facility
* Mechanical spring balance load set-up

c. Digital PID controller for closed operation.

* Intel 8051 Microcontroller based CPU card
* 2 Row x 16 Column LCD Dot Matrix with back light Display Alphanumeric Display
* single Channel Single ended Analog Input Range : (0-5)V DC
* Single Channel Analog Output (0-5) Volt
* One I/V Converter and V/I converter provided
* 4 Number of keys provided to give set point, increment, Decrement function etc.
* In-Built IC regulated power supply
* Provision to change any one of the following,
  Input : (0-5)V
  Output : (0-5)V

11. AC Servo Motor Position Control Trainer (PEC - 02)

This trainer designed for versatile applications/Experiments mentioned above.

It consists of,

* An AC Servo motor mounted on a open frame
* Power driver to control speed of the motor
* To study speed servo control of AC servo motor.
* One Optical sensor provided for speed sensor and display on a 3½ digit display

This trainer system is a compact & advanced version for class room experiment set up for the students to operate and study a practical speed measurement using AC Servo motor.

Features

* One 230V/11.5 (Control Voltage) Two phase AC servo motor mounted on a open frame
* Speed Range : 0 to 1500 RPM geared down in 1:30 ratio
* One Optical sensor coupled to shaft to measure speed.
* AC Servo Motor's speed is controlled by varying control voltage (11.5V)
* Direction of the motor is varied by phase reversal of the control voltage
* Mechanical loading arrangement provided

Power Supply

* Input 230V ±10%, 50Hz, Single phase AC
* ±15V at 0.5A DC regulated output for control circuitry

Suggested Experiments

1. Speed measurement of AC servo motor using optical sensor.
2. Study of closed loop control of a AC servo motor
* Study of Characteristics of AC servo motor
  i. Speed Vs Armature Voltage ii. Speed Vs Torque iii. Armature current Vs torque
* To determine the transfer function of the AC servo motor.

12. Transfer Function of 2Φ AC Servo Motor Speed Control (Open / Closed Loop) system (PEC 00A)

* This trainer is designed to drive the two phase AC servo motor both open loop and closed loop. And study of transfer function of motor.
* Two phase AC servo motor :
  Main winding voltage : 230V AC
  Control winding voltage : 12V AC
  Speed : 1500RPM
  Mechanical loading arrangement.
* Speed sensor (optical type) fixed on the motor shaft for feedback & speed display.
* It consists of SCR based AC regulator for control winding voltage variation (0 - 12V AC variable, .5Amp capacity).
* Op-amp based linear triggering circuit for SCR AC regulator.
* One no. toggle switch to select open loop, closed loop-operation.
* One no. digital speed indicator to indicate set speed and actual speed.
* Provision to control the motor speed through external 0 - 5V DC source.
* 230V, 50Hz AC input, +15V / -15V DC for control circuits.

Suggested Experiments

1. Open loop speed control of AC servo motor
2. Closed loop speed control of AC servo motor
3. Transfer function of AC servo motor

13. Transfer Function of AC Servo Motor (VPET - 302)

This setup consists of

i. 100W Two phase AC servo motor setup
ii. Variable AC voltage source

i. 100W Two Phase AC servo motor setup

* Main winding voltage 230V AC
* Control winding voltage 0-230V AC (90° phase shift)
* Optical speed sensor for speed measurement
* Belt type mechanical loading arrangement
* Speed (0-1500 RPM)
* Power - 100W

ii. Variable AC voltage source

* One number of 1 Φ,1 Amp Auto transformer provided to vary 0-230V AC for control unit
* One number of Phase shift transformer provided for 90° Phase shifting of main wing voltage
* Fuse provided for CW over current protection
* Illuminated power ON/OFF switch provided for CW & MW voltage input
* One No. of digital ammeter provided for control winding current measurement
* One No. of Digital voltmeter provided for control winding voltage measurement
* One No. of MC Based digital speed indicator for motor speed measurement
* 3 Φ Input, all are mounted on a nice cabinet
* One no. of Experimental manual

Suggested Experiments

1. Measurement of motor transfer function
2. Speed control of AC servo motor

14. Transfer Function of Dc Servo Motor (VPET - 300A)

This setup consists of,

a. 100W DC Separately excited DC servo Motor setup
b. Variable AC/DC source with meter setup

a. 100W Separately Excited DC Servo Motor :

* Armature Voltage : 0-48V DC, 2.7 Amp
* Field Voltage : 0-48V DC
* Shunt type separately excited

* Speed : 1500 rpm
* Rating : 100W
* One Inductive proximity sensor provided to sense the speed
* Double side shot extension with speed indication
* Mechanical loading arrangement

b. Variable AC/DC Source :

* One no. of IGBT based variable DC power supply using chopper circuit provided for both armature and field circuit.
* Over load protection for armature section is provided.
* One no. variable AC source for motor inductance measurement.
* One no. of DC digital voltmeter (0-50V) provided for Armature voltage measurement
* One no. of DC digital ammeter (0-5A) provided for Armature current measurement.
* One no. of (0-50V) DC digital meter provided for Field Voltage measurement
* One no. of (0-2A) DC digital ammeter provided for field current measurement
* One no. of (0-50V)AC digital Voltmeter for AC Voltage measurement
* One no. of (0-1)A AC digital ammeter for AC current Measurement
* One no. of Digital stop-clock provided for time.

Suggested Experiments

* Determination of Armature & Field parameters
* Determination of Motor mechanical parameters
* Derivation of "Transfer Function" of Separately excited Motor.

b. Transfer function of DC Servo Motor

This setup consists of,

a. 100W DC Separately excited DC servo Motor setup
b. Manual.

a. 100W Separately Excited DC Servo Motor :

* Armature Voltage : 0-48V DC, 2.7 Amp
* Field Voltage : 0-48V DC
* Shunt type separately excited
* Speed : 1500 rpm
* Rating : 100W
* One Optical Encoder provided to sense the speed
* One 3½ Digital Display provided to display the speed
* Double side shot extension with speed indication
* Mechanical loading arrangement

b. Manual :

* Detailed Experimental Manual provided to explain :
  # To measure the motor parameters
  # Determination of Transfer function.

15. Transfer Function of DC Motor / Generator Transfer Function Study Trainer (PEC14HV1)

* This trainer is designed to drive the 1HP DC motor (optional), So that

varies parameters of DC motor/generator can be found experimentally.

* It consist a package of IGBT with 6 no of IGBTS and drive circuit fabricated on a single chip.
* IGBT 4 quadrant chopper is used to control the armature voltage (0-100v) and single quadrant chopper is used to control field voltage (150-220v)
* One no of LCD is provided to display speed Duty cycle of pwm of armature and field.
* Five no of micro mini swtich's provided for selection and control of different process.
* Military standard connectors are provided for armature and field supply voltage of termination.
* Speed sensor interfacing provision is available on the module of operate under closed loop.
* Vdspic4011 Microconroller pwm generation circuit is implemented.
* Separate variac is provided to measure the impedance of the armature & field windings.
* One no of analog voltmeter is provided to view the DC link voltage.
* The current protection is implemented to the rating of motor supplies.
* Four No's DPM for armature current, voltage and field current, voltage measurement.

Suggested Experiments

1. Determination of transfer function of armature controlled DC motor.
   A. Speed Vs Armature - voltage transfer function
   B. Speed Vs torque transfer function
   C. Armature current Vs voltage transfer function
   D. Current Vs torque trans function.
2. Determination of transfer function of field controlled DC motor.

16. Ward - Leonard Speed Control System of DC Shunt Motor (PEC14HV2)

* This trainer is designed to drive the 1HP DC motor (optional) using ward Leonard system so that varies parameters of DC motor can be found experimentally.
* It consists of,
  1. 1HP AC motor coupled with 1HP DC generator.
  2. 1HP DC motor with mechanical loading arrangement.
* It consists of SCR based fully controlled converter for field voltage variation (0 - 200V DC variable, 1AMP) of DC generator.
* One no. SCR based AC regulator for motor / generator winding inductance measurement. (0- 100V AC, 1AMP variable)
* One no. diode bridge converter for DC motor filed voltage (200V fixed).
* One no. DPM for field voltage measurement.
* One no. potentiometer used to vary field DC voltage. One no. toggle switch to reverse the voltage.
* Over current, field failure protection. MCB for input ON/OFF.

Suggested Experiments

1. Determination of transfer function of armature controlled DC motor
   A. Speed Vs Armature - voltage transfer function
   B. Speed Vs torque transfer function
   C. Armature current Vs voltage transfer function
   D. Current Vs torque trans function.

17. Micro Controller Based Slip Ring Induction Motor Speed Control Using Static Krammer Drive (PEC16HV10B)

* This is designed for microcontroller controlled static slip power recovery drive in constant torque mode for steady state and transient state analysis including effects of core loss and saturation.
* This hardware will be suitable for speed control of Slip Ring Induction motor and monitoring many motor parameters for research purpose.
* The full system consists of a 3 phase slip ring induction motor with mechanical loading
* 3 phase converter to convert the rotor output to a DC link voltage
* A R-L filter to smoothern & reduce the ripple in the DC output voltage of the converter.
* A 3 phase line commutated thyristorised inverter controlled by a Microcontroller based system.
* The microcontroller based system is meant to provide firing pulses to thyristors of the inverter & motor, all motor parameters etc.

Detailed Specifications

* Slip Ring Induction Motor : 1 H.P, 3 Phase 400V/440V, 50Hz, 0.75 KW, R.P.M 1440, with suitable rotor volts 210V or so and current 6 amp rating continuously
  # Make : Benn
  # Volts : 400/440V, 3 phase, 50 Hz
  # 0.75 KW (1 hp), RPM : 1440
  # 2.5 Amps
  # Rotor Volts : 210 Volt
* DC Generator as Load :
  # Make : Kirloskar /Grampton Greaves
  # 5 hp, 1500 rpm
  # Resistive load of 4 KW provided
* Both Slip Ring Induction motor and DC Generator are coupled together. One optical encoder is provided for the speed measurement. The output of optical encoder is signal conditioned & calibrated to indicate the speed of the motor & display on a 3½ digit display.
* Converter - Inverter unit for slip power recovery scheme with inverter being Microcontroller controller (8051) thyristor [PIV = 1200V, Current 25 Amp.] having a filter (R-C) in between for filtering ripples of output DC of converter/uncontrolled rectifier.
* Converter :
  # 6 Diodes, 120 volt PIV, 25 Amp to form the bridge
  # Fuse provided.

* Inverter :
  # 6 Thyristors, 1200 Volt PIV @ 25 amp
  # The SCRs are mounted on suitable heat sinks and Snubber circuit is provided to each device.
* One 3ϕ Transformer provided to feedback the recovered power to the line. One Auto Transformer provided, controls manually the power feed back to the line.
* Power meters provided at various points to monitor to power consumed.
* A power control panel is provided to fix various Volt meters, Current meters, and Power meters.
* The panel consists of
  a) Auto Transformer
  b) ON/OFF Switch
  c) Volt meter
  d) Current meter
  e) Switches to select various options.
  f) One Volt meter, One Current meter to show the generator Voltage output and Current output.
* 3 Ammeters to show the 3 phase currents of Inverter output.
* One Ammeter and One Voltmeter to show the Current and Voltage output of the Converter.
* 3 Ammeter provided to show the 3ϕ Current outputs of Rotor.
* 3 Ammeter provided to show the 3ϕ Current outputs of Stator.
* 3 Ammeter and One Voltmeter provided to monitor the 3ϕ current input from the line.
* Hall-effect current transducer are provided to measure i. Stator Currents, ii. Rotor Currents iii. Converter Output Current iv. Inverter output currents
* Hall-effect voltage transducer are provided to measure voltages at various points of the experimental setup (Fig.4).
* Necessary test points provided for obtaining oscillographic waveform record of supply voltage, supply current, stator voltage, stator current, DC link voltage, DC link current, inverter feedback current and rotor current waveforms.

The above setup is able to measure the following parameters,

a. Steady state Behaviour of Drive
b. Transient state Behaviour of Drive

The Software has provision to record the following in the computer and graphical hard copy can be taken.

1. No Load speed Vs. firing angle characteristics
2. Torque - speed characteristics at different firing angle [95° to 160° in step 10 or by user setting]
3. Torque (2P.U) Vs. DC link current (0 P.U to 3.75 P.U at firing angle 95° to 145°)
4. Full load supply current Vs. slip characteristics at firing angle 95° to 145°
   [Here supply current is computed as phasor sum of stator current and inverter current on A.C side]
5. Supply power factor Vs. slip (P.U) Characteristics at different firing angle
6. System efficiency Vs. slip curves at different angle at full load
   # Determination of Transfer function

18. DSP Based Static Krammer drive (PEC16HV10C)

It consists of three major parts namely,

* SCR 3 phase inverter
* DSP Based inverter firing circuit
* Slip ring induction motor setup with rotor converter circuit & RL For DC filtering

SCR 3 phase Inverter

* It consists of 6 Nos. of SCRs rated at 1200V, 50Amp with suitable heat sinks to form 3 phase fully controlled converter work as a 3phase inverter ($\alpha > 90°$)

DSP Based inverter firing circuit

* TMS320F2407A DSP Based firing circuit.
* Six Isolated gate signals for Full Bridge Converter.
* Firing Angle variable from 180° to 0° through Ramp and pedestal control.
* Gated carrier source at 4 KHz.
* Housed in a Sleek cabinet.
* Test points are provided on the front panel for detailed study of circuit signals by the student.
* Necessary test points are terminated at sockets so that the student can monitor/ measure/study the signals using CRO, DVM, etc.,
* One potentiometer to vary the firing angle.
* One ON/OFF switch with indicator provided to power the control circuitry so that the students can monitor all the test points of the control circuitry for correct functioning.

Slip ring motor with diode bridge rectifier

* 3 phase 1 hp slip ring induction motor
  - # Make : Benn
  - # Volts : 400/440V,3 phase, 50 Hz
  - # 0.75 KW (1 hp), RPM : 1440
  - # 2.5 Amps
  - # Rotor Volts : 210 Volt
* One no. of 3 phase bridge rectifier is provided to convert rotor circuit volt 13%, 210V to DC
* One no. of 'L' & 'R' provided for DC filtering
* Necessary test points provided for easy study
* Entire control circuit mounted inside a compact box
* Mimic circuit is drawn in the front panel
* Many test points are provided along with front panel
* A Nice text-lab manual is provided
* Power Supply :
  - # Input:230V ± 10%, 3 phase AC
  - # ±15V DC @ 0.5A regulated output for the control circuitry.

VI. STANDALONE SCR TRAINERS

1. UJT Characteristic and Oscillator Study Module (PEC14M5)

This module has been designed to study and demonstrate the building up a UJT

Relaxation Oscillator and use this circuit to trigger a SCR. This circuit also provides a Time Delay. Most of the circuit points are terminated on SPRING, the individual components can be inserted externally by students, which makes a student a deep understanding in the UJT Relaxation circuit.

* UJT Relaxation Oscillator is used to generate triggering pulses for SCR.
* By using UJT Relaxation Oscillator the SCR is working as a ON DELAY TIMER and AC Regulation.
* Circuits to study UJT Relaxation Oscillator.
* Most of the circuit points are terminated on spring so that components can be inserted externally.
* Maximum components can be inserted through spring termination externally for students study .
* 3 Sockets are provided to insert externally a SCR.
* One External Transformer provided ; 230V Input, O/P 24-0-24V AC @1Amp.
* Housed in a sleek box.

Applications

1. Study of UJT Relaxation Oscillator.
2. Study of ON Delay Timer.
3. AC Regulator using SCR

2. Digital Measurement of Phase Angle (PEC14M9)

* Measurement of phase different between 2 sine waveform
* Resistor - Capacitor (RC) circuit to shift one waveform up to 90° to stimulate phase difference
* One 3½ Digit display to display 0-90°phase angle
* Input signal sources

Power Supply

Input 230V ±10%, 50Hz single phase AC
±15V DC @ 0.5A regulated output for the trigger circuits.

3. AC Solid State Relay Using Opto-coupler Isolation (PEC14M10)

* 555 IC used to generate triggering pulse to SCR/TRIAC.
* 6N137 opto used to isolate the gate signal.
* SCR based AC regulator triac based AC regulator.
* TYN612 SCR, BTA12 TRIAC used as a power device.
* Connector provided external 5V/15VDC input.
* Lamp used as a load.
* Input : 230VAC.
* Output : 230V AC, 5AMP
* Control signal 5V/15VDC

4. SCR Ring Counter (PEC14M11)

* Five No's SCR used as a power device.
* Five No's lamp used (as a load) to view ring counter operation.
* Auto / manual mode of operation.
* One no. SPDT switch to select manual / auto mode of operation.
* 555 IC based as table multivibrator for auto mode operation.
* One no. push - to on switch provided for mono stable input trigger.
* One no. reset switch to re - start the operation.
* Transistor based pulse amplifier for pulse amplification.
* One no. bridge rectifier converters 230V AC to DC with filter circuits for SCR power circuit input.
* Five No's AC capacitor used for SCR commutation.
* 230V AC input, 15V DV for control circuit.

Suggested Experiments

1. Testing of SCR ring counter in auto mode with different frequency.
2. Testing of SCR ring counter in manual mode.

5. Fast Recovery Diode Characteristics Study Module (VPET - 304)

* This module consists of oscillator circuit for switching pulse generation
* One BJT driver
* One BJT for power switching

* One Fast Recovery diode
* One slow regulated diode module / rating 700V/1A
* One 24V regulated DC voltage for power switching
* One mains ON/OFF switch for control circuit
* One min, max switch for frequency selection
* Test points provided to test the waveform mounted on a front panel.
* Schematic diagram is screen printed in the front panel.

6. AC Phase Control Using SCR, TRIAC & DIAC (PEC14M22)

* It consists of UJT firing circuit & SCR AC regulator, DIAC firing circuit with TRIAC AC regulator.

UJT Firing Circuit with SCR AC Regulator

* Line synchronized UJT triggering circuit, line synchronization achieved by 230V / 9V step down transformer.
* Built in 24V AC for firing circuit input. One No's Toggle switch to ON/OFF 24V AC.
* One no. Potentiometer used to vary the firing angle [10° - 170°degree].
* 1:1:1 Pulse transformer used for gate pulse isolation.
* Pulse outputs are terminated in the PCB for external connection.
* Two No's TYN612 SCR connected in antiparallel forms SCR AC regulator with termination.

DIAC Firing Circuit with Triac Ac Regulator

* One no. Potentiometer and different values of capacitor and one no. DIAC forms DIAC firing circuit.
* Two No's Toggle switch to select different value of capacitor.
* One no. BTA12 TRIAC used as a AC regulator with termination.
* One no. 100W lamp used as a load.

Suggested Experiments

1. SCR AC regulator using UJT firing circuit.
2. TRIAC AC regulator using DIAC firing circuit.

7. SCR DC Circuit Breaker(VPET- 100)

* SCR Based Complementary commutated chopper used as a DC circuit breaker.
* Two No's TYN612 SCR with heartsick used for main and auxiliary SCR.
* One no. AC capacitor used for commutation.
* One no. fixed resistor used as load for auxiliary SCR circuit.
* One no. current sensing resistor provided in main SCR for load current sensing.
* Three No's SPDT provided for load current variation.
* One no. push-to on switch to on the main SCR.
* One no. push-to on switch to auxiliary SCR (to off main SCR).
* Two No's LED to indicate the two SCR on status.
* One no. DC ammeter (0 - 3Amp) for load current indication.
* One no. 30V DC , 3Amp unregulated power supply for circuit breaker input.
* One no. toggle switch to ON/OFF DC power supply. Fuse provided for protection.

Suggested Experiments

1. Testing of DC circuit breaker with different current setting.

8. Zero Voltage Switching using SCR/TRIAC (PEC14M19)

Hardware Details

* Model : PEC14M19
* Integrated circuit based (3059/3079) ZVS circuit
* Power circuit consists of one SCR and one TRIAC user can select either one device at a time.
* 24V AC Operation
* External Resistor/Lamp load provided
* All output of IC's provided by banana connectors, so users can patch and study ZVS.
* One No Pot. is provided for vary the frequency of Ramp (used for ZVS applications)
* One No Pot. is provided for vary the AC cycle. (used for ZVS applications)
* Mimic diagram provided in PCB, fixed nice powder coated cabinet.

Experiments

* Study of ZVS using TRIAC
* Study of Half cycle ZVS using SCR
* ZVS Application :
  # Study of integral cycle control using TRIAC (or) H.W. Integral cycle control using SCR

PART - II - IGBT / MOSFET RELATED PRODUCT

I. IGBT/MOSFET STATIC AND DYNAMIC CHARACTERISTICS TRAINER.

1. BJT, IGBT, MOSFET-Characteristics Trainer (PEC16M1)

* Basic switching characteristics study trainer.
* Consists of three separate sections for IGBT, MOSFET and BJT power circuit.
* Each sections consists of power device and driver section and fixed load resistors.
* Transistorized Darlington amplifier used for driver circuit.
* One no. fixed +15V / 1Amp DC power supply for power section input.
* One no. toggle switch used to ON/OFF +15V DC with LED indication.
* 555 IC based square wave generation for device base input.
* One no. toggle switch to select two range of frequency.
* For IGBT/MOSFET characteristics switching frequency is 5KHz and for BJT 7 KHz.
* All three sections base/gate input and collector/drain inputs are terminated at banana sockets.

Suggested Experiments for All Three Devices

1. Measurement of On- delay period (T_D - ON)
2. Measurement Rising period (T_R)
3. Measurement of Turn - On period (T - ON)
4. Measurement of Conduction period (T)
5. Measurement of Storage period (T_S)
6. Measurement of Falling period (T_F)
7. Measurement of Turn - OFF period (T-OFF)
8. Measurement of OFF - period

2. IGBT, MOSFET, SCR, TRIAC, DIAC Characteristics Study Trainer (PEC16M1-A)

* Basic static characteristics study trainer.
* LM 723 based variable DC power supply (0-30V) for SCR Vak.
* LM 723 based variable DC power supply (0-12V) for gate voltage of all devices.
* Separate section for SCR/TRIAC characteristics.
* Separate section for IGBT/MOSFET characteristics.
* Two No's fixed load resistor for all devices.
* Four No's potentiometer to vary all voltages.
* LED indication for all power supply.
* Three No's. digital multimeter for measurement of device parameters.
* 230V AC input with Power ON/OFF switch.

Suggested Experiments

1. Study of VI characteristics of SCR.
2. Study of VI characteristics of TRIAC.
3. Study of Transfer characteristics of MOSFET.
4. Study of Transfer characteristics of IGBT,
5. Study of Dynamic characteristics of MOSFET.
6. Study of Dynamic characteristics of IGBT

3. IGBT Characteristics Trainer (VPET - 202)

* Consists of one IGBT power device
* One no. of 12V fixed DC power supply and one no.of 30V fixed power supply for characteristics of IGBT
* One no.of potentiometer to vary the gate current
* One no. of potentiometer to vary the collector current
* Fixed load resistor
* Power ON/OFF switch provided
* All necessary points terminated in the front panel
* Provision for connecting ammeter and voltmeter

4. Transient Characteristics of SCR and MOSFET (VPET - 216)

a) Transient Characteristics of SCR

* One SCR (TYN 612) with proper heat sink
* Turn-ON transient (OR) turn off transient characteristics can be studied.
* IC Based square wave generation for V_{AK} and V_{GK}
* One No. of fixed load resistor.

b) Transient Characteristics of MOSFET :

* One IRF840 MOSFET with heat sink
* One no. 15V/30V power supply (Built-in) for V_{DS}
* One no. of 555 based square wave generation with transistor driver circuit
* One no. of fixed load resistor.

c) Power Supply

* 230V AC Input, ±15V DC for control circuit
* Power ON/OFF switch with indication.

5. DYNAMIC CHARACTERISTICS OF MOSFET,BJT & IGBT (VPET-216A1)

This set up is designed to study the TURN ON & TURN OFF Characteristics (Dynamic characteristics) of power devices like MOSFET, IGBT & BJT devices. This set up consists of.

Features

* One number of MOSFET with proper heat sink is provided.
* One number of BJT with proper heat sink is provided.
* One number of IGBT with proper heat sink is provided.
* One no of Square wave pulse generator circuit is provided for power devices Gate circuit.
* One number of variable DC voltag circuit is provided for power device input.
* One no of potentiometer is provided for DC voltage adjustments.
* One number of Fixed R Load is provided for MOSFET circuit.

* One number of Fixed R Load is provided for BJT circuit.
* One number of Fixed R Load is provided for IGBT circuit.
* Current sensing resistor is provided for all devices collector current measurement
* All necessary block outputs are terminated by 4m connectors by external patching
* All are mounted on wood box with diagram printed PCB
* 230V AC input with power ON/OFF switch.

6. Characteristics of MOSFET & IGBT (VPET - 202A)

* Consists of one IGBT and one MOSFET power device
* One no. of step down transformer, diode bridge rectifier and Filter capacitor and 7812 regulator forms +12V DC, 30V DC supply for device voltage variation.
* One no.of potentiometer to vary the gate current
* One no. of potentiometer to vary the collector current
* Fixed load resistor
* Power ON/OFF switch provided
* All necessary points terminated in the front panel
* Provision for connecting ammeter and voltmeter

II. IGBT/MOSFET BASED LOW VOLTAGE APPLICATION TRAINERS.

1. MOSFET MODULE(VPET-106M)

* It consist of one number of diode (metal package)with heatsink is provided .
* MOSFET IRF840 with rating of 500V & 8A.
* Drain & source terminals are terminated at banana sockets.
* RC snubber circuit is provided along with fuse for other circuit protection.

2. IGBT MODULE (VPET-106I)

* It consist of one number of diode (metal package)with heatsink is provided. IGBT, CT60AM with rating 600r, 60A
* The gate, collector & Emitter terminals of are brought out & terminated at banana connectors.
* RC snubber circuit is provided along with fuse for other circuit protection.

3. SINGLE PHASE MOSFET MODULE (PEC16M2)

* Four no. IRF840 MOSFET with heatsink and snubber circuit.
* 6N137 High speed opto for gate PWM isolation.
* IR2112 / 2110 Driver IC for gate PWM drive.

* IC Based dead time logic circuit implemented to avoid pulse shoot through.
* Built in 50 / 30V DC, 2Amp for power circuit input.
* Over current protection circuit implemented with LED indication.
* All devices terminated individually for different configuration.
* By suitable interface with external firing module (PEC16M4 / M5 - optional) it can be work as

    1. Single quadrant chopper
    2. Two quadrant chopper
    3. Four quadrant chopper unipolar
    4. Four quadrant chopper bipolar
    5. Single phase SPWM inverter.
    6. Single phase single pulse inverter.

* All four device gate pulse inputs are terminated on the front panel for external interface (Microprocessor / MC / DSP).
* 230V AC input, +15V / - 15V DC for control circuits.
* Optionally a hall-effect current transducer provided for current measurement.

4. Single Phase IGBT Module (PEC16M3)

* Four no. IRGBC - 20S IGBT with heatsink and snubber circuit.
* 6N137 high speed opto for gate PWM isolation.
* IR2112 / 2110 Driver IC for gate PWM drive.
* IC Based dead time logic for delay circuit.
* Built in 50 / 30V, 2Amp DC for power circuit input.
* Over current protection circuit with LED indication.
* All devices terminated individually for different configuration.
* By suitable interface with external firing module (PEC16M4 / M5) it can be work as

    1. Single quadrant chopper
    2. Two quadrant chopper
    3. Four quadrant chopper unipolar
    4. Four quadrant chopper bipolar
    5. Single phase SPWM inverter
    6. Single phase single pulse inverter

* All four device gate pulse inputs are terminated on the front panel for external interface(MP / MC / DSP, etc.,).
* 230V AC Input , +15V / -15V DC for control circuits.
* Optionally a hall-effect current transducer provided for current measurement.

5. Single Phase PWM Inverter Control Module (PEC16M4#1)

* Four no. gate signal to trigger four IGBT / MOSFET.
* IC Based carrier (triangular) wave generation with variable frequency.
* One no. potentiometer used to vary the carrier frequency (2KHz to KHz).
* IC Based reference sine / square / trapezoidal wave generation with variable amplitude & frequency.
* One no. rotary switch to select different type of reference waves.
* Two no. potentiometer used to vary the frequency, amplitude of reference signal.
* LM311 Based comparator circuit. it compares carrier & reference wave.

* One no. rotary switch to select PWM for different types of modulation sin / trapezoidal/ square.
* One no. toggle switch with debounce logic for PWM ON/OFF.
* All four PWM outputs are terminated on the front panel for device module interface (PEC16M2 / M3).
* 230V AC Input, +15V / -15V DC for control circuits.
* This module can be interfaced with IGBT module (PEC16M3) or MOSFET module (PEC16M2).
* The following experiments can be done using this firing module & device module combination.
    1. Single phase sine PWM inverter.
    2. Single phase square PWM inverter.
    3. Single phase trapezoidal PWM inverter.

6. Single Phase Inverter Control Module (PEC16M4#2)

* Four no. gate signal to trigger four IGBT / MOSFET.
* IC Based carrier (triangular) wave generation with variable frequency.
* One no. potentiometer used to vary the carrier frequency (2KHz to 4KHz).
* IC Based reference square wave generator with variable amplitude.
* Potentiometer used to vary the frequency, amplitude of reference signal.
* LM311 Based comparator circuit. It compares carrier & reference wave.
* One no. toggle switch for PWM ON / OFF.
* All four PWM outputs are terminated on the front panel for device module interface.
* 230V AC input. +15V / -15V DC for control circuits.
* This module can be interfaced with IGBT module (PEC16M3) or MOSFET module (PEC16M2).
* The following experiments can be done using this firing module & device module.

    1. Single phase single pulse square PWM inverter.

7. Chopper Control Circuitry Module (PEC16M5)

* Four no. gate signal to trigger four IGBT/MOSFET.
* IC Based carrier (triangular) wave generation with variable frequency.
* Potentiometer used to vary the carrier frequency (2KHz to 4KHz).
* LM311 Based comparator circuit. it compares carrier & control voltage.
* One no. potentiometer used to vary the control voltage so as to vary the duty cycle ratio of PWM (5% to 95%).
* IC Based control logic circuits for generation of PWM for different type of chopper (Single/Two/Four quadrant).
* One no. rotary switch to select PWM for different types of chopper circuits.
* One no. toggle switch for PWM ON/OFF.
* All four PWM outputs are terminated on the front panel for device module interface (PEC16M2/M3).
* 230V AC Input, +15V / -15V DC control circuits.
* This module can be interfaced with IGBT module (PEC16M3) or MOSFET module (PEC16M2) optionally.

The following experiments can be using this firing module & device module Combination.

1. Single quadrant chopper
2. Two quadrant chopper
3. Four quadrant chopper - unipolar
4. Four quadrant chopper - bipolar

8. Three Phase IGBT Power Module (PEC16HV2A)

* Power Module is designed for Motor control Applications and UPS Application.
* IGBT & DIODE used as power device.
* Input : 1 Phase 50 Hz AC.
  Output : i. 3ϕ AC (V/F) control for 3 ϕ drive applications ii. 3ϕ AC Output for UPS Applications (Voltage control)
* 1200V, 25A, 3 Phase IGBT Inverter Bridge package
* Additional Features
* 1200V, 25A converter Bridge for AC-DC power conversion
* 1 No. of Hall Effect current sensors to sense the output current of the Inverter Bridge
* All the PWM signals are isolated using Opto Isolator
* Protection circuit for over current with LED indication
* Independent Power supplies for all Isolated circuits.
* Voltmeter to Indicate the DC Link Voltage
* All current, PWM's & Feedbacks are terminated at Front panel
* FRC Connectors are provided to Interface with the External digital controllers
* All the Input/Output Lines are Terminated at Banana sockets.

9. CHOPPER/INVERTER PWM CONTROLLER (PEC16HV2B)

This module provides the gating signals for a three phase full bridge inverter and chopper obtained through a sine pulse width modulation (PWM) technique.

FEATURES

* It generates 6 Nos. of PWM to trigger the 6 IGBTs provided in the device module for Inverter application (Device module Optional)
* Sine PWM technique is used.
* 3 Phase sine wave (with 120° phase shift) generated through ICs
* Frequency and amplitude (V,F or V/F) can be controlled by adjusting potentiometer
* One no.of carrier wave generation block (Generate 3KHz Frequency)
* 3 Nos. of PWM IC generate PWM with comparison of each phase & carrier wave
* 3 PWM inverted by using NOT gate
* Final output of 6 PWM used to trigger 6 Nos. of IGBT/MOSFET (Device module) with frequency, amplitude control
* Test points are provided to check the waveforms at various stages of the PWM circuitry
* Built in power supplies for the control circuitry, 230V, 50Hz, ±15V & 5V.
* The module is bought out in a sleek box.

10. IGBT BASED CHOPPER CIRCUIT (PEC16M3 / M5)

* It consists of four quadrant chopper control circuit, IGBT power circuit, load etc.,

CHOPPER CONTROL CIRCUIT

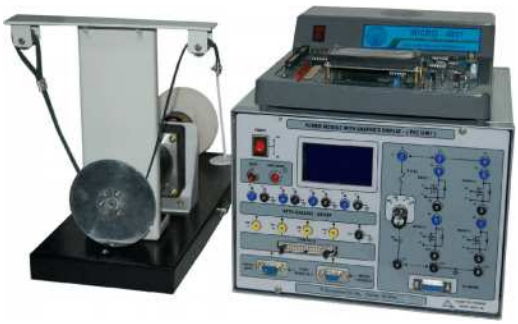
* IC Based carrier (triangular) wave generation with variable frequency.
* One no. potentiometer used to vary the carrier frequency (2KHz to 4KHz).
* LM311 Based comparator circuit. It compares carrier & control voltage.
* One no. potentiometer used to vary the control voltage so as to vary the duty cycle ratio of PWM (5% to 95%).
* IC Based control logic circuits for generation of PWM for different type of chopper.
* One no. rotary switch to select PWM for different types of chopper circuits. (single, two, four - quadrant chopper).

IGBT POWER CIRCUIT

* Four no. IRGBC - 20S IGBT forms H-Bridge circuit.
* Necessary IGBT terminations for single quadrant chopper / two quadrant chopper.
* LM723 Based 24V DC power supply with O/C, S / C protection.
* One no. toggle switch, fuse protection and LED indication for 24V DC supply.
* One no. fixed resistive and inductive load, 5V DC (back - EMF) provided.
* All four PWM inputs are terminated on the front panel for device module interface.
* 230V AC input, +15V / - 15V DC for control circuits.

11. Hybrid Control of AC/DC Drives [Vcs-Ser 01]

This is an advanced digital system trainer for the students to operate and study the practical position and speed control of AC, DC & Stepper Motor under



* Micro controller based stand alone operation
* Matlab-Simulink based operation.
* Microcontroller based AC Servo Motor speed control.
* Microcontroller based DC Servo Motor speed control.
* Microcontroller based AC Servo Motor position control System.
* Microcontroller based DC Servo Motor Position control System
* Study of PI control in the setup.
* Study the Characteristics of Stepper Motor.
* Interfacing with MATLAB and can perform all the possible experiments based on this system.

Vcs-Ser01 consists of the following:

* Microcontroller based PWM Controller (Micro - 4011)
* Power Module with graphics display (PEC16M7)
* Motor setup (AC servo/DC servo/Stepper Motor) (Vcs-Acm1/Dcm1/Stm1)
* MATLAB Compatibility (Vcs-Mat1)

12. Speed Control of AC & DC Drives [VSPM-LCD 01]

* This module is used to drive the 3 phase AC & DC motors. It is operate at single phase AC input 230V. Protection circuits provided for over current and over temperature. This is work with the dsPIC controller of dsPIC 4011. Open/Closed loop function can be able to done by using different selection.

Module Specification

* Input Voltage 230V-1⌀
* Output AC ≈165V AC Average.
* Output DC 0-50V
* Feedback proximitive sensor input.
* Speed control switches for up and down will be provided.
* Controller dsPIC 4011 based 16 bit operation of PWM generation.

Motor Specification

* 415V AC/100W squirrel cage induction motor.
* 50V/2A PMDC motor.
* Coupled and fixed in a mechanical frame.
* AC motor is loaded by DC motor generator.
* DC motor is loaded by mechanical spring balance setup.
* Speed sensing arrangement provided in the shaft.

III. IGBT/MOSFET BASED HIGH VOLTAGE APPLICATION TRAINERS

1. Single Phase Input IGBT Based Three Phase Inverter (PEC16HV5)

* Six no. IGBT (IPM) forms H-bridge three phase sine PWM inverter.
* Sine triangle PWM generation for IGBT. switching frequency 2.5HKz.
* One potentiometer used to vary the reference sine wave (R,Y,B) frequency.
* One potentiometer used to vary the reference sine wave (R,Y,B) amplitude.
* High speed opto coupler used for pulse isolation.
* Built in driver IC in PWM power circuit.
* Three no. hall-effect sensor for output, DC current measurement and protection.
* LED indication for over current, short circuit condition.
* Three phase diode bridge converter and filter capacitor for input DC voltage for IGBT inverter power circuit.
* One voltmeter indicate DC rail voltage , MCB for input ON/OFF , over current.

Specification

* Input voltage : 230V AC, 50Hz.
* Output voltage : Three phase [0 - 240V] AC (variable voltage) each phase, [10-50Hz] (variable frequency) each phase,
* Output rating : 10Amp (each phase).
* Motor / RL can be used a load. open / closed loop possible (optional).

2. IGBT Based Four Quadrant Chopper (PEC16HV3)

Power Module

* Power Module is designed for Motor control Applications.
* IGBT & DIODE used as power device.
* Input : 1 Phase 50 Hz AC.
  Output : i. 3ϕ AC (V/F) control for 3 ϕ drive applications ii. 3ϕ AC Output for inverter applications (Voltage control)
* 1200V, 25A, 3 Phase IGBT Inverter Bridge package
* Additional Features
* 1200V, 25A converter Bridge for AC-DC power conversion
* 1 No. of Hall Effect current sensors to sense the output current of the Inverter Bridge
* All the PWM signals are isolated using Opto Isolator
* Protection circuit for over current with LED indication
* Independent Power supplies for all Isolated circuits.
* Voltmeter to Indicate the DC Link Voltage
* All current, PWMS & Feedbacks are terminated at Front panel
* FRC Connectors are provided to Interface with the External digital controllers
* All the Input/Output Lines are Terminated at Banana sockets.

Control Module

* Vdspic4011 based pwm generator for four quadrant chopper circuit.
* Two no. of potentiometer are provided, one to vary the duty cycle of armature circuit and another duty cycle of field circuit.
* Pulse ON/OFF switch is provided to enable or disable the pulse at the pulse output connector.
* One no. of toggle switch is provided to select either four quadrant chopper mode or speed control mode.
* One no. of toggle switch is provided to select either open loop or closed loop operation.
* One no. of push to ON switch is provided to Reset the module.
* Four no. of push to ON switch is provided to select either forward running or Breaking or Reverse running or Breaking.
* One no. of ON/OFF section is provided to power ON/OFF total module .
* Testing point terminals are provided for armature pwm and field pwm signals.
* One no. of LCD is provided to view the duty cycle of armature and field pwm signal and speed of motor.
* One no. of 'D' socket is provided to interface with inductive speed sensor to read the speed

Specification

* Input voltage : 230V AC, 50Hz.
* Output voltage : [0 to 180V] DC
* Output rating : 5Amp
* Separate opto, driver circuit provided for single quadrant chopper.
* Motor / R&L load can be as load. (optional)current.

3. Three Phase Input Igbt Based Four Quadrant Chopper (PEC16HV7)

* Four no. IGBT (IPM) forms H-bridge four quadrant unipolar chopper circuit.
* Separate firing circuit for unipolar PWM generation (PWM frequency 5KHz)
* One potentiometer used to vary the duty cycle ratio.
* High speed opto coupler used for opto coupler used for pulse isolation.
* Built in driver IC for IGBT (IPM) gate drive.
* Three no. hall-effect current sensor for output, DC current measurement and protection.
* Output over current, short circuit protection with LED indication.
* Three phase diode bridge converter and filter capacitor for input DC voltage of IGBT chopper power circuit.
* One voltmeter indicate DC rail voltage, MCB for input ON/OFF, over current.

Specification

* Input voltage : 440V AC, 3phase, 50Hz.
* Output voltage : [0 to 200V] DC [0to-200V] DC (variable voltage)
* Output rating : +10Ams.
* Two no. IGBT forms two quadrant chopper. (for field circuit).
* Separate control circuit for PWM generation.
* One pot used to vary the dutycycle ratio of PWM.
* Separate opto, driver circuit provided for two quadrant chopper.

4. 500VA On-line/off-line UPS Trainer (PEC16HV4)

* This set up consists of 24V battery module, battery charger, UPS controller module.

Battery

* 2No. 12V, 60AH Battery connected in series, with fuse protection.

Battery Charger

* SCR Based battery charger.
* Current set potentiometer for setting charging current.
* LED indication for over / triggle charge
* 230V AC input.

UPS Controller

* MOSFET Based push-pull inverter.
* SG3525 used for PWM generation.
* Three no. potentiometer used to vary frequency, duty cycle, dead time.
* Separate cycle for battery level monitoring with low / high volt LED indication.
* Provision to select online / offline UPS.
* More than 10 no toggle switch for fault analysis.

Specifications

* Capacity : 500V A
* Input voltage : 24V DC
* Output voltage : [150 - 230V] AC (variable voltage) [45-55Hz] (variable frequency)
* Output rating : 2.5A

5. DSP Based 500VA UPS Trainer (PEC16HV-DSUPS)

This trainer is designed to study the working principle of solar panel powered or SCR Mains converter powered DSP Based UPS system. This trainer consists of,

a. IGBT Based Single phase SPWM inverter
b. TMS320F2407A DSP based PWM Controller

c. Battery (24V/48V)
d. Solar panel based Battery Charger / SCR Based Battery Charger

a. IGBT/MOSFET Based Single phase SPWM Inverter

* 4 Nos. of IGBT/MOSFET with suitable heat sink and snubber circuit forms H-Bridge inverter
* One no. of Inverter transformer used for IGBT output for step-up the voltage and Isolation.
* One no. of LC Filter used to Filter the inverter output voltage.
* One no. of Voltage sensing transformer and current sensing transformer for feedback voltage for closed loop and protection.
* One no. of filter capacitor for DC input.

b. TMS320F2407A DSP Based PWM Controller

* Digital signal processor (TMS320F2407) used to generator 1ϕ SPWM Pulses to trigger IGBT & to generate single phase converter gate pulse for battery charger.
* 4 Nos. of PWM output used to generate 4 PWM (IGBT/MOSFET)
* 2 Nos. of PWM output used to generate 2 Pulses (SCR)
* 2 Nos. of ADC Used to sense the Inverter output voltage and current for feedback
* 1 No. of ADC used to read the battery voltage level for monitoring and protection
* 1 No. of ADC used to read the battery current for protection and monitoring.
* 1 No. of I/O used sense the main AC Status.
* 6N137 Opto used to isolate the 4 PWMs
* IR3210 Drive IC used for IGBT gate driver
* One no. of LCD display used to Indicate the Main Volt & current, Battery voltage & current and Inverter Voltage & current.
* Provision to select ON line /OFF line UPS.

DSP Controller used for

* To generate sine PWM pulses to trigger IGBT/ MOSFET inverter
* To generate gate pulses for SCR battery charger
* To select and control the various functions like,
  # Inverter closed loop
  # Inverter over current protection
  # Solar / SCR Battery charger selection
  # Mains sensing
  # SCR Battery charger closed loop operation
  # Battery charger over current protection
  # Battery deep discharge/over charge protection
  # Selection of Solar charger / SCR Charger
  # Selection of on line/off line mode of operation
* Display of all parameters like current, voltage and temperature etc.

c. Battery Module

* 24V/48V, 90 AH Battery
* Two nos. of 12V Battery connected in series
* One no. of current sensing transformer and voltage sensing circuits for battery monitoring and protection.

d. Battery Charger

i) Solar panel based battery charger
ii) SCR Mains converter based battery charger

i) Solar Panel based Battery Charger

* 1KW / 0.5KW solar panel with necessary accessories to charge 24/48V Battery.

ii) SCR Mains converter based battery charger

* 2 Nos. of SCR & Diode forms 1ϕ half controlled converter for battery charging
* 230V AC Input, 24/48V DC output
* One no.of LC Filter
* Two no.of pulse transformer for pulse isolation and pulse amplification circuits.

Technical Specifications

* Input : 24V/48V DC
* Output : 1ϕ, 230V (Sine wave output)
* Capacity : 1KW

Protection Circuit

* Inverter over current shut down with buzzer indication
* Battery deep discharge and over charge cut-off protection with indication
* Battery over current cut-off protection with indiction.

PC Based Software

* Windows based powerful software to operate the DSP based UPS trainer system
* It displays all parameters of UPS
  # Inverter Voltage
  # Inverter current
  # Battery voltage
  # Battery current
  # Temperature
  # ON line / OFF line mode of operation
* RS232 interface provision to UPS.

6. IGBT Based Three Phase PWM Inverter (PEC16HV2A)

This trainer consists of three sections,

a. Digital controller for i. Sine PWM & Multiple PWM generator ii. PWM Generation for 3 phase AC Drive iii. PWM Generation for 3 phase UPS.
b. 3 Phase IGBT Based power module
c. Battery with charger (Optional)

a. dsPIC 30F4011 Based controller for SPWM/Multiple PWM Generator

* Microchip's dsPIC30F4011 16 Bit Digital Signal Controller Operating at 33 nS & 30 MIPS.
* On Chip - Motor Control Peripherals
* 6 Motor Control PWM Unit with Programmable Dead Band, 10 Bit, 9 Channel ADC with 500 KSPS, 30 General Purpose I/O Lines, 5 GP Timers, Quadrature Encoder Interface & 4 Input Capture Pins.
* Memory (On- Chip)
  # 48K Flash Program Memory.
  # 2K RAM for Data Memory.
  # 1K EEPROM Memory.
* Additional Features
  # On Chip serial port and the serial port lines are isolated
  # ADC Input Lines are protected and Terminated.
  # Bead Inductances are provided at VCC & GND for EMI Rejection.
  # PWM Output Lines are Terminated at a separate FRC Connector.
  # 16x2 Alphanumeric LCD Display and 3 keys Keypad
  # Switch Mode Power Supply
  # Input : 180V-230V AC, 50-60 Hz
  # Output : +5V/3.0A & +/- 12V/500 mA
  # Protection : Over Current & Short circuit Protection
* Provision to select different type of PWM control technique (SPWM / Multiple PWM)

* Provision to select PWM output for UPS/3ϕ AC Drive applications.

b. 3ϕ IGBT Based Power Module

* Power Module is designed for Motor control Applications and UPS Application.
* IGBT & DIODE used as power device.
* Input : 1 Phase 50 Hz AC.
  Output : i. 3ϕ AC (V/F) control for 3 ϕ drive applications ii. 3ϕ AC Output for UPS Applications (Voltage control)
* 1200V, 25A, 3 Phase IGBT Inverter Bridge

Additional Features

* 1200V, 25A converter Bridge for AC-DC power conversion
* 1 No. of Hall Effect current sensors to sense the output current of the Inverter Bridge
* All the PWM signals are isolated using Opto Isolator

* Protection circuit for over current with LED indication
* Independent Power supplies for all Isolated circuits.
* Voltmeter to Indicate the DC Link Voltage
* All current, PWMS & Feedbacks are terminated at Front panel
* FRC Connectors are provided to Interface with the External digital controllers
* All the Input/Output Lines are Terminated at Banana sockets.
* 0.5hp 3ϕ AC Induction Motor (3ϕ, 200V, 1415 RPM)

IV. IGBT/MOSFET BASED AC/DC DRIVES

1. Speed Control of Single Phase Induction Motor Using IGBT Inverter (V/F CONTROL).(PEC16HV1)

1. V/F Control of Single phase Induction Motor

This setup consists of

a. Smart power module [VPET106A]
b. Chopper / Inverter controller module[PEC 16HV2B]
c. 1hp Single phase AC Motor setup

a. SMART POWER MODULE [VPET 106A]

* Uncontrolled Bridge rectifier Rated for 600V @ 35 Amps for converting AC input to DC link voltage
* DC link capacitors provided
* 6 Nos of IGBTs from a package of 6 devices contribnute to form full bridge Inverter with one set of bridge is 180degree out of phase from the other.
* Snubber circuit is provided to each device.
* High speed Optos are provided to isolate gate control circuitry
* IGBT IC drivers are used to drive switches.
* Output: 0 to 220Volt AC @ 5 Amp
* One MCB provided to switch on the AC input to the power circuit
* One DC Voltmeter provided to measure the DC link voltage
* One hall-effect current transducer provided in the DC link bus and used for protection.
* The AC output of IGBT bridge is terminated at banana sockets.
* One Hall-effect current transducer provided in the AC output line and used for protection.
* Test points provided on the Front panel (DC-link Current, DC-link Voltage, AC output current)

CONTROL MODULE [PEC16HV2B]

* Vdspic4011 based pwm generator for four quadrant chopper circuit.
* Two no. of potentiometer are provided, one to vary the duty cycle of armature circuit and another duty cycle of field circuit.
* Pulse ON/OFF switch is provided to enable or disable the pulse at the pulse output connector.
* One no. of toggle switch is provided to select either four quadrant chopper mode or speed control mode.
* One no. of toggle switch is provided to select either open loop or closed loop operation.
* One no. of push to ON switch is provided to Reset the module.
* Four no. of push to ON switch is provided to select either forward running or Breaking or Reverse running or Breaking.
* One no. of ON/OFF section is provided to power ON/OFF total module .
* Testing point terminals are provided for armature pwm and field pwm signals.
* One no. of LCD is provided to view the duty cycle of armature and field pwm signal and speed of motor.
* One no. of ‘D’ socket is provided to interface with inductive speed sensor to read the speed.

Protections

* The protection circuit monitors
  i) AC output current
  ii) DC-link voltage
  iii) DC-link current and takes appropriate protection like Over Voltage, Under Voltage and Over Load
  # One LED to indicate the Shut Down condition due to protection.
* One Reset switch is provided to restart the operation.
* One Control & Power circuit in DC rail for Breaking over voltage

Input Circuitry

* One Potentiometer provided to vary the AC Output voltage
* One potentiometer provided to vary the frequency of the output voltage Range: 10Hz-100Hz
* One SPDT switch provided to release gate pulses
* 5 Test points are provided for
  i) Carrier frequency
  ii) PWM 1 and PWM 2 pulses
  iii) DC link current
  iv) load current
* One Rocker switch provided to power the equipment.

b. Digital PI Controller for Closed loop operation

* Intel 8051 Microcontroller based CPU card
* 2 Row x 16 Column LCD Dot Matrix with back light Display Alphanumeric Display
* Single Channel Single ended Analog Input Range : (0-5)V DC
* Single Channel Analog Output (0-5) Volt
* One I/V Converter and V/I converter provided
* 4 Number of keys provided to give setpoint, increment, Decrement function etc.
* In-Built IC regulated power supply
* Provision to change any one of the following,

  Input : (0-5)V
  Output : (0-5)V

c. 1hp Single phase AC Motor setup :

* 1hp Single phase Permanent capacitor induction motor
* 230V AC Input
* 1400 rpm.
* Spring balance load setup
* Speed sensor with digital speed indication with speed feedback facility.(0-5V)

d. Isolation Transformer

* Used for power circuit input voltage isolation
* Input : 230V AC
* Output : 110-0-110V AC
* 1KVA Capacity.

2. Speed Control of Slip Ring Induction Motor Using IGBT Chopper (PEC14HV10-A).

This module consists of three blocks,

1. Motor mounted on a mechanical frame
2. Three phase converter-inverter
3. Inverter firing control circuitry

Main Features

* Rotor voltage is controlled to vary the motor speed
* One transformer to feedback the recovered power to the line
* Efficiency is improved by returning power into AC system bus
* Wound rotor Induction motor mounted on a mechanical frame (3hp, 3ϕ, 1410 rpm slip ring induction motor)

* Optical encoder with speed motor (Optional).
* One DC Generator coupled with motor to load the motor (Optional)
* Entire control circuit mounted inside a compact box
* Mimic circuit is drawn in the front panel
* Many test points are provided along with front panel
* A Nice text-lab manual is provided.

3. DC Position Control System. (PEC-01)

This trainer system is a compact & advanced version for class room experiment set up for the students to operate and study a practical position control system. A variety of Experiments can be conducted using this Trainer system.
The DC motor position control trainer consists of,

1. Controller
2. Converter
3. Mechanical Setup

Controller

* 2 Analog PI controller provided for speed control & position control (One Optional)
* Each PI controller provided with Front panel variable setting for,
  a. Variable gain for Proportional controller (P)
  b. Variable Integral Time for Integral controller (I)

Converter

* 4 Quadrant MOSFET chopper provided for forward & reverse direction
* MOSFET driver provided

Mechanical Setup

* One PMDC 12 volt with Gear provided
* Motor speed 1500 rpm
* Gear ratio 30 : 1 to run 50rmp speed
* One Servo potentiometer provided at the low speed shaft
* Optionally one PMDC Motor can be coupled to the motor as load

Other Features

* One Tachogenerator is provided for speed feedback.
* One 3½ digit display can be used to display the actual & reference position (3 digit)

4. DSP Based DC Motor Position Control (VPET - 107)

This trainer system is a compact & advanced version for class room experiment set up for the students to operate and study a practical position control system. A variety of Experiments can be conducted using this Trainer system.

The DC motor position control trainer consists of,

1. DSP based Controller
2. Converter
3. Motor Setup

DSP Based Controller

* One powerful DSP controller with software
* 16x2 Alphanumeric display provided to display the speed, position and velocity
* 6x2 matrix keyboard provided to feed the input

Converter

* 4 Quadrant MOSFET Chopper circuit to drive the motor
* Dual MOSFET driver with 4 MOSFET and bridge rectifier with filtering circuit also provided

Motor Setup

* 12V/1.5A PMDC Motor with gear 30:1 ratio
* Quadrature optical encoder of 512 ppr in the without gear side.
* One opto coupler provided for zero sensing
* This setup fixed in a metal base plate

Other Features

* Built-in Power supply
* Cables provided to link the mechanical setup and controller unit.

Experiments

* Speed control of DC Servo motor
* Position control of DC servo motor
* Measure the velocity.

5. Amplidyne Characteristics Trainer [VPET-403]

Amplidyne Generator Set

Comprising :
Capacity : 1KW
Voltage : 220/110V DC
Speed : 3000 RPM

Amplidyne Generator Set (A.C. Motor - as Prime Mover) :

* The above Amplidyne Generator will be directly coupled with one 2 KW capacity protected type AC squirel Cage Induction Motor suitable to operate on AC 400/440V, 3 phase, 50 cycles/Sec. Speed will be 2900/3000RPM.

Rating : Continuous
Cooling : Self Fan Cooled Type
Mounting : Horizontal Foot Mounting

Coupling & Mounting

* Both the above Amplidyne Generator and the AC Motor will be placed on a fabricated channel iron common base plate and to be coupled with each other by means of a flexible coupling.

Control Gear

* The above Amplidyne Generator will be provided with one Amplidex unit consisting of suitable excitation Rectifier, choke, fine control potentiometer for excitation control and necessary control fuses.
* The above AC Motor will be provided with one direct on-line starter with Thermal Overload protection Relays.

6. Speed Control and Electronics Braking of DC Shunt Motor. [VPET-404]

This trainer is designed to study speed control (Forward/Reverse) and various types of Electrical braking of DC shunt motor (1hp).Armature and Field control of DC Shunt Motor

a) DC Shunt Motor :
   * 1 HP
   * Armature voltage : 180V
   * Field Voltage : 220V
   * Shunt type
   * 1500 RPM
   * Speed display facility

b) MOSFET Controller

i. Armature control circuit

* MOSFET Based chopper circuit to vary armature voltage 0-200V DC.
* IC based PWM controller circuit with opto isolator and gate drive circuit
* Open loop operation

* One potentiometer used to vary the Armature Voltage

b) ii. Field Control Circuit

* MOSFET Based chopper circuit to vary Field voltage 100V-220V DC
* IC based PWM controller circuit with opto isolator and gate drive circuit
* One Potentiometer used to vary O/P voltage

c. Other Features

* One no. of Push-button for braking operation
* One potentiometer used to set % of braking(10% - 90%)
* One no. of push button for Inching operation

7. Electrical Braking Three Phase Induction Motor [VPET-405]

This trainer is designed to study the working principle and demonstrate various section of a Three phase IGBT Based SPWM Inverter & V/F Control. This trainer is provided with Hall Effect Current Transducers at required lines for protection and used for measuring the current.
The front panel mimic diagram shows various section of the trainer like Power circuitry, Protection, Input circuitry etc. Various Test points provided at the front panel allows the students to study various signals of the circuitry of the trainer
.

Features

* IGBT based sine wave Inverter Output.
  Input : 230V AC
  3ϕ Output : 5 Amps per Phase
  Frequency : 10Hz - 50Hz
* Hall Effect Current Transducer provided to measure DC link voltage and AC output
* Various protection circuits provided
* Mimics circuit screen printed in the front panel.
* More than 8 Test points are provided
* Housed in a sleek box.

Power Circuit

* Uncontrolled Bridge rectifier Rated for 600 @ 35Amps for converting AC input to DC link voltage
* DC link capacitors provided
* 6 Number of IGBTs are provided to form three half bridges.
* Snubber circuit is provided to each device.
* High speed Optos are provided to isolate gate control circuitry
* IGBT IC drivers are used to drive switches.
* Output: 0 to 220Volt AC @ 5 Amp at each phase.
* One MCB provided to switch on the AC input to the power circuit
* One DC Voltmeter provided to measure the DC link voltage.
* One hall-effect current transducer provided in the DC link bus and used for protection.
* The AC output of IGBT bridges are terminated at banana sockets.
* Two Hall-effect current transducer provided in the Two phase output lines and used for protection.
* Test points provided on the Front panel (DC-link Current, DC-link Voltage, 3 Phase output currents.)

Protections

* The protection circuit monitors

  i) DC-link voltage
  ii) DC-link current

iii) 2 Phase output currents and takes appropriate protection like Over Voltage, Under Voltage and Over Load

One LED to indicate the Shut Down condition due to protection

* One Reset switch is provided to restart the operation.
* One Control & Power circuit in DC rail for Breaking over voltage

Input Circuitry

* One Potentiometer provided to vary the AC Output voltage
* One potentiometer provided to vary the frequency of the output voltage Range:10Hz-50Hz
* One SPDT switch provided to release gate pulses
* 5 Test points are provided for
  i) Carrier frequency
  ii) PWM 1,PWM 2 and PWM 3 pulses
  iii) DC-link current
  iv) load current(Optional)
* One Rocker switch provided to power the equipments.

V/F Controller

* Separate circuits provided to V/F control
* One Potentiometer provided to vary the V/F Ratio.

Other Features

* One no. of push button for DC current braking
* One potentiometer used to set different % of DC braking (10% - 50%)

Power Supply

* Input 230V ±10%, 50Hz, Single phase AC

Accessories

1. 1 hp three phase AC induction motor mechanical loading (PEC14HVACC13)
   * Make : Siemens.
   * Fixed on a mechanical frame
   * One optical encoder is provided for the speed measurement.
   * The output of optical encoder is signal conditioned & calibrated to indicate the speed of the DC motor & display on a 3½ digit display.

8. Synchro Transmitter and Receiver (PEC - 03)

* Two number of torque synchro used as a transmitter and receiver
* Rotor Voltage : 50V AC, 50Hz
* Induced Stator Voltage : 22V AC, 50Hz three phase
* The input and output angular displacement is indicated in a round dial marked with angular position (0-360º)
* Rotor (R1, R2) and Stator (S1,S2,S3) terminals of transmitter & receiver are terminated by banana connector in the base plate
* One no. of Digital AC Voltmeter used to indicate stator/rotor voltage of transmitter (or) receiver
* One no. of 230V/50V AC Step-down transformer for rotor voltage input.
* Two nos. of ON/OFF switch for rotor voltage of transmitter/receiver
* One no. of power ON/OFF switch with indication
* All are mounted on a nice cabinets.

V. DC-DC CONVERTER /SMPS TRAINER

1. Single & Multiple Output SMPS Trainer (VSMPS - 02)

* This set up consists of three separate modules,1. Input power module 2. SMPS controller 3. Electronic load.

Input Power Module

* 230V / 24V, 3Amp step down transformer Used to give isolated 24V AC for SMPS input.
* One no. auto transformer used to vary the 24V AC [0-24V]AC.
* One no. analog voltmeter indicate the AC output voltage [0-30V]AC.
* Fuse & LED provided.
* Used for line regulation.
* SMPS CONTROLLER :
* IRF250 MOSFET based forward converter.
* TL 494 Used for PWM generation. PWM frequency at 63KHz (APP).
* 6N137 Opto used for pulse isolation.
* One potentiometer used to vary the frequency of PWM (study module).
* One potentiometer used to vary the ref-voltage of controller (S.M).
* Provision to select single / multi output.
* Output filtered by LC filter. Varies fault analysis switches.

Electronic Load

* Transistor based (single quadrant chopper circuit.) load instead of resistive load.
* Separate circuits for PWM generation.
* One potentiometer used to vary the duty cycle ratio so as load current.
* Voltmeter / Ammeter for output voltage.
* Used for LOAD regulation.

Specification

* Input : [0 - 24V] AC
* Output : 5V, 2Amp (single output)
  5V, 2Amp, +12V/ .5A,
  -12V/ .5A

2. PUSH PULL INVERTER (PEC16M11)

* Two nos. of IRF840 MOSFET used as a power device
* High frequency transformer used to isolate the output signals
* TL494 used to generate PWM for MOSFET
* Two nos. of Potentiometer used to vary duty cycle ratio, frequency of PWM
* 24V DC Input, 12V DC Output, 1 Amp
* Necessary test points.

3. DC Series Resonant Converter Trainer (VPET - 315)

* Series loaded series resonant converter with zero-current switching
* MOSFET used as a Power device
* 24V DC input for power circuit.

4. MOSFET Based Buck Converter (VSMPS 05A)

* One number of powers MOSFET IRF840 used as power switch with suitable heat sink.
* TL494 IC based PWM generator.
* One number of high speed Opto isolator provided for PWM isolation.
* Driver IC IR2110 used to drive power switch.
* High frequency transformer provided for isolation.
* Power circuit I/P voltage : +15V DC.
* Output voltage 0 - 5 VDC/1 amp.
  230V AC input ,+15 DC for control circuit.
* One number of fuse provided for protection.
* Voltage feed back from the output for closed loop operation.
* One no. of Potentiometer used for PWM variation
* L & C provided for filters.

5. MOSFET Based Boost Converter (VSMPS 06A)

* One number of powers MOSFET IRF840 used as power switch with suitable heat sink.
* TL494 IC based PWM generator.
* One number of high speed Opto isolator provided for PWM isolation.
* Driver IC IR2110 used to drive power switch.
* High frequency transformer provided for isolation.
* Power circuit I/P voltage +15V DC. Output voltage 0 - 25 VDC/1 amp.
* One number of fuse provided for protection.
* Voltage feed back from the output for closed loop operation.
* L & C Provided for filtering

6. MOSFET Based Buck Boost Converter (VSMPS 07A)

* It consists of two sections A) DC chopper control Circuit with variable duty cycle ratio b). MOSFET based chopper power circuit
* IC based PWM Generator
* One no. of Potentiometer used to vary duty cycle of PWM signal (10% - 75%) Necessary test points provided to study the control circuit
* One no. of IRF 840 MOSFET used as a power switch
* 5V/10V DC unregulated power supply for power circuit
* One ON/OFF switch provided for power circuit input voltage
* By adjusting duty cycle output voltage can be varied
* One no. of analog DC voltmeter
* Output Voltage < input (Boost mode)
* Output Voltage > Input (Buck Mode)
* All are mounted on a wooden box
* Input 230V, 115V DC for power circuit

7. MOSFET Based Forward Converter (VSMPS 08A)

* One number of powers MOSFET IRF840 used as power switch with suitable heat sink.
* TL494 IC based PWM generator.
* One number of high speed Opto isolator provided for PWM Isolation.
* Driver IC IR2110 used to drive power switch.
* High frequency transformer provided for isolation.
* Power circuit I/P voltage +15V DC.
* Output voltage 0 - 5 VDC/1 amp.
* 230V AC input ,+15 DC for control circuit.
* One number of fuse provided for protection.
* Voltage feed back from the output for closed loop operation.

8. MOSFET Based Fly Back Converter (VSMPS 09A)

* One number of powers MOSFET IRF840 used as power switch with Suitable heat sink.
* TL494 IC based PWM generator.
* One number of high speed Opto isolator provided for PWM isolation.
* Driver IC IR2110 used to drive power switch.
* High frequency transformer provided for isolation.
* Power circuit I/P voltage +15V DC.
* Output voltage 0 - 5 VDC/1 amp.
* 230V AC input ,+15 DC for control circuit.
* One number of fuse provided for protection.
* Voltage feed back from the output for closed loop operation.

All components are mounted on a nice cabinet with necessary test points & terminals. One no. of Rheostat provided for load. Necessary ammeters & voltmeters provided.

PART -III OTHER PRODUCTS

I. POWER ELECTRONICS TRAINERS FOR POLYTECHNICS

1. Single Phase Half-controlled Converter (VPET -204)

* Consists of scr firing circuit, half-controlled scr power circuit and R-L load.
* TCA-785 IC based firing pulse generation.
* One number potentiometer provided for firing angle adjustment (0-180°).
* 230/9V synchronization transformer provided for firing circuit.
* Carrier logic implemented for pulse with on/off switch.
* Pulse transformer used for gate pulse isolation.
* All pulses are terminated in the pcb for scr patching
* Two no. TYN-612 scr and power diode used for power circuit.
* Necessary test points provided for waveform measurement.
* 24V AC, 2amp provided for power circuit input with on/off switch.

2. Single Phase Fully Controlled Converter (VPET-205)

* Consists of scr firing circuit ,fully-controlled scr power circuit and R-L load.
* TCA-785 ic based firing pulse generation.
* One number potentiometer provided for firing angle adjustment (0-180d).
* 230/9V synchronization transformer provided for firing circuit.
* Carrier logic implemented for pulse with on/off switch.
* Pulse transformer used for gate pulse isolation.
* All pulses are terminated in the PCB for scr patching.
* Four No. TYN-612 scr with heatsink provided for power circuit.
* Necessary test points provided for waveform measurement.
* 24V AC ,2amp provided for power circuit input with on/off switch.

3. Three Phase Fully Controlled Converter [VPET-215]

* Consists of SCR power circuit, Firing circuit
* 6 Nos. of SCR, TYN612 with heat sink & snubber circuit
* TCA785 based 3 phase firing pulse generator
* One Pot used to vary firing angle (180°-0°)
* 6 Nos. 1:1 pulse transformer used to isolate the gate pulses.
* Gate carrier logic input provided
* One no. SPDT used for PWM ON/OFF
* Low voltage step - down transformer for power circuit input.
  # Input : 230,230,230V
  # Output : 24,24,24V, 3A
* Fixed R, L Load

4. Three Phase Half Controlled Converter [VPET-218]

* Consists of SCR power circuit, Firing circuit
* 3 Nos. of SCR, TYN612 with heat sink & snubber circuit, 3 Nos. of Power diode.
* TCA785 based 3 phase firing pulse generator
* One Pot used to vary firing angle (180°-0°)
* 3 Nos. 1:1 pulse transformer used to isolate the gate pulses.
* Gate carrier logic input provided
* One no. SPDT used for PWM ON/OFF
* Low voltage step - down transformer for power circuit input.
  # Input : 230,230,230V
  # Output : 24,24,24V, 3A
* Fixed R, L Load

5. RAMP&PEDESTAL Trigger Circuit for AC Load (VPET-203)

* Consists of BTA12 triac based ac regulator for lamp intensity control.
* TCA785 ic based firing pulse generation to trigger triac
* One number of potentiometer used ac variable R-
* One number of potentiometer provided for firing angle adjustment.(0-180d)
* Pulse transformer provided for gate pulse isolation 230v on/off.
* pulse output terminated in the pcb with on/off switch.
* Necessary test points provided for firing circuit waveform measurement.
* 230v ac input for power circuit with on/off switch, fuse protection.
* One number of 230v lamp provided for load.
* One number 230/9v step-down transformer provided for output waveform measurement in CRO.

6. Three Phase AC Voltage Regulator Trainer [VPET-215B]

* Consists of SCR power circuit, Firing circuit
* 6 Nos. of SCR, TYN612 with heat sink & snubber circuit
* TCA785 based 3 phase firing pulse generator
* One Pot used to vary firing angle (180°-0°)
* 6 Nos. 1:1 pulse transformer used to isolate the gate pulses.
* Gate carrier logic input provided
* One no. SPDT used for PWM ON/OFF
* Low voltage step - down transformer for power circuit input.
  # Input : 230,230,230V
  # Output : 24,24,24V, 3A
* Fixed R, L Load
* Experiment :
  # Testing of 3 phase AC Voltage regulator using R, RL Load.

7. DC Chopper Trainer (VPET -208)

* Consists of single quadrant chopper control circuit, mosfet power circuit & load.
* TL494 pwm controller IC based pwm generation for mosfet chopper.
* One number of potentiometer provided for pwm frequency adjustment.
* One number of potentiometer provided for pwm duty cycle adjustment.
* High-speed opto provided for pwm isolation.
* IR2110 driver ic used for pwm driving.
* IRF840 mosfet used for power circuit.
* 24V DC,2amp provided for chopper power circuit input.
* One number on/off switch with indication provided for dc voltage.
* 230V AC input,+15V DC for control circuit.

8. Line Synchronized UJT Triggering Module (VPET-200)

* Consists of ujt firing circuit, scr power circuit & load.
* 2N2646 UJT based firing pulse generation.
* 230/24vac provided for ujt firing circuit input and also line synchronization.
* 1:1 pulse transformer used for gate pulse isolation.
* One number of potentiometer used for firing angle adjustment.(10-170)°.
* Pulse output terminated at connector in the pcb for scr patching.
* One number TYN612 scr with heat-sink, fixed load resistor forms half-wave controlled converter power circuit.
* 24V AC,2amp provided for power circuit input with on/off switch.
* Fuse provided for protection.

9. LAMP CONTROL USING DIAC-TRIAC (VPET-201)

* Consists of triac based ac regulator for lamp intensity control.
* DIAC, R & C used for triac firing pulse variation.
* One number of potentiometer used ac variable R-for firing angle variation.
* 230V AC input for power circuit.
* One number of illuminated switch provided for 230V on/off.
* Fuse provided for input side to avoid overload.
* One number of 230V lamp provided for load.
* One number 230/9V step-down transformer provided for output waveform measurement in CRO.
* All are mounted in the PCB fixed with wooden cabinets.

10. Basic Series Inverter Trainer (VPET-207)

* Consists of scr firing circuit ,scr inverter power circuit, output L-C filter.
* IC based firing pulse generation to trigger two SCRs.
* One number of potentiometer provided for firing pulse frequency variation(300-600Hz).
* Pulse transformer used for gate pulse isolation.
* Pulse output terminated at connector in the PCB for scr patching.
* Two number of TYN612 scr, inductor, capacitor forms basic series inverter power circuit.
* 24V DC,2amp provided for series inverter power circuit input.
* One number of toggle switch provided for dc on/off with indication.
* Necessary test points provided for varies sections for waveform measurement.
* 230V AC input,+15vdc for control circuit input.
* All components are mounted in the PCB fixed with wooden cabinet

11. Single Phase Cycloconverter Module (VPET-209)

* Consists of cycloconverter firing circuit, SCR power circuit, load.
* IC based firing pulse generation to trigger four SCR.
* One number of potentiometer provided for firing angle variation(0-180°).
* Two number of toggle switch provided to select output frequency 50Hz, 50/2, 50/3, 50/4Hz etc.
* Pulse transformer provided for gate pulse isolation.

* All four pulses terminated in connector for SCR patching.
* Four number of TYN612 scr with heat sink and center tapped inductor provided for power circuit.
* 24-0-24V AC, 2amp provided for power circuit input.
* One number of fixed resistor provided for load.
* One number of toggle switch provided for AC on/off.
* Necessary test points provided for waveform measurement.
* 230V AC input,+15/-15VDC for control circuit.

12. DC Motor Speed Control Trainer [VPET-211]

* One no. of Phase control IC used for pulse generator
* One no.of potentiometer used to vary firing the firing angle (0-180°)
* Pulse amplifier and pulse isolation provided
* 2 Nos. of 1:1 pulse transformer used for pulse isolation
* Necessary test points and SCR input and output connectors are provided for easy studying and patching

Power circuit

* It consists of SCR power circuit for DC Motor Armature, Diode rectifier for FIELD circuit

Armature Circuit

* 4 Nos. of SCR with heat sink form fully controlled converter
* 230V AC input
* One no. of SPDT to ON/OFF power circuit input voltage
* One no. of fuse provided for output section
* All G,K terminals brought out by special connectors
* Connector output terminated by banana socket for Motor Armature.

Field Circuit

* One no. 1ϕ diode bridge rectifier (Package) provided
* 230V AC Input for diode rectifier
* One no. of ON/OFF switch for AC Input
* Bridge output terminated by connector for motor field.
* One no. of LED Indicate field voltage status

13. Speed Control Circuit for Universal Motor [VPET-212]

* One no. of Phase control IC used for pulse generator
* One no.of potentiometer used to vary firing the firing angle (0-180°)
* Pulse amplifier and pulse isolation provided
* 1 No. of 1:1 pulse transformer used for pulse isolation
* TRIAC used as power device
* 230V AC used for power circuit input
* Necessary test points and SCR input and output connectors are provided for easy studying and patching

* One no. of SPDT provided to ON/OFF AC Input
* One no. LED indicate the input AC Status.
* Universal motor as load

14. Closed Loop Control of Fhp AC Induction Motor [VPET-213]

* One no. of Phase control IC used for pulse generator
* One no.of potentiometer used to vary firing the firing angle (0-180°)
* Pulse amplifier and pulse isolation provided
* 2 Nos. of 1:1 pulse transformer used for pulse isolation
* 2 Nos. of SCR used as power device
* 230V AC used for power circuit input
* Necessary test points and SCR input and output connectors are provided.
* One Analog PI controller for closed loop operation
* One FHP AC Induction motor without loading arrangement (Make : Panasonic) with tacho feedback arrangement.
* One no. of fuse provided for output section for output current protection
* One no. of SPDT Provided to ON/OFF AC input
* One no. Digital speed indicator provided to indicate set/actual speed of the motor.

15. DC Motor Speed Control Trainer (CLOSED LOOP) [VPET-214]

Ramp and Pedestal Trigger circuit

* One no. of Phase control IC used for pulse generator
* One no.of potentiometer used to vary firing the firing angle (0-180°)

* Pulse amplifier and pulse isolation provided
* 2 Nos. of 1:1 pulse transformer used for pulse isolation
* Necessary test points and SCR input and output connectors are provided for easy studying and patching

Power Devices Crcuit

* Four nos of SCRs rated for 1200 volts- VAK & 25 Amps 1A
* One diode for free wheeling
* Each device is provided with
  # RC Snubber for dv/dt protection
* Necessary terminals are terminated on connectors
* 24volt AC @ 2Amp provided for low voltage operation
* In the low voltage operation the student can see the waveform using an Oscilloscope without any Isolation Transformer
* One no. of fuse provided at output section for over current part.
* One no. of SPDT to ON/OFF power circuit AC Input
* One no. of Digital speed indicator indicate set/actual speed of motor.

Analog PI Controller

* One analog PI Controller provided for closed loop operation

Load

* 24V PMDC Motor
* Make :Panasonic with output feedback facility.

PART -IV POWER ELECTRONICS ACCESSORIES

I. LOW VOLTAGE ACCESSORIES

A. RESISTIVE LOAD (PEC LV ACC1A)

1. PECLVACC1A 50Ω/4A Rheostat

* 50 Ohm / 4amp rating
* Variable type,
* Single phase AC or DC input
* Tubular type.

2. 220Ω/2A Rheostat (PEC LV ACC1B)

* 220 Ohm / 2amp rating
* Variable type,
* Single phase
* Tubular type.

B. INDUCTIVE LOAD (PEC-LV ACC2)

1. INDUCTIVE LOAD (PEC-LV ACC2A)

* 120Mh , 4Amp Rating
* Single phase inductive load
* With 0,15,30,45,60,75,90,120mH tapping
* Iron core type.
* Banana connector provided for all inputs.

2. INDUCTIVE LOAD (PEC-LV ACC2B)

* 150Mh , 5Amp Rating
* Single phase inductive load
* With 0,50,100,150 mH tapping
* Iron core type.
* Banana connector provided for all inputs.

C. MOTOR LOAD (PEC LV ACC3)

1. 12V PMDC MOTOR LOAD (PEC LV ACC3A)

* Volt 12V DC or 24V DC
* Amp 1.5A DC
* Torque - 1kgcm
* Speed 1500 rpm
* Double side shaft extension
* Speed sensor with digital speed indicator

II. HIGH VOLTAGE ACCESSORIES

A. LOADING RHEOSTAT (PEC-HV ACC1)

1. SINGLE PHASE LOADING RHEOSTAT (PEC HV ACC1A)

* 1kw rating
* Single phase input
* Different selector switch provided for current selection.
* Fuse provided for input protection.
* Banana connector provided for load input

2. SINGLE PHASE LOADING RHEOSTAT (PEC HV ACC1B)

* 3kw rating
* Single phase input
* Different selector switch provided for current selection.
* Fuse provided for input protection.
* All are mounted on a moveable cabinet.
* Banana connector provided for power input.

3. THREE PHASE LOADING RHEOSTAT (PEC HV ACC1C)

* 1kw rating
* Three phase input
* Different selector switch provided for current selection.
* Fuse provided for input protection.
* All are mounted on a moveable cabinet.
* Banana connector provided for load input

4. THREE PHASE LOADING RHEOSTAT (PEC HV ACC1D)

* 3kw rating
* Three phase input
* Different selector switch provided for current selection.
* Fuse provided for input protection.
* All are mounted on a moveable cabinet.
* Banana connector provided for load input

B. INDUCTIVE LOAD (PEC-HV ACC2)

1. SINGLE PHASE INDUCTIVE LOAD (PEC HV ACC2A)

* 5AMP capacity
* Variable type
* Single phase input.
* Banana connector provided for input.
* Fuse provided for protection

2. THREE PHASE INDUCTIVE LOAD (PEC HV ACC2B)

* 5AMP capacity
* Variable type
* Three phase input.
* Banana connector provided for input.
* Fuse provided for protection.

3. THREE PHASE INDUCTIVE LOAD (PEC HV ACC2C)

* 5AMP capacity
* Variable type
* Three phase input.
* Banana connector provided for input.
* Fuse provided for protection.

C. MOTOR LOAD (PEC HV ACC3)

1. 1 hp dc shunt motor spring balance load set-up [PEC HV ACC3A]
2. 1 hp dc shunt motor generator load set-up [PEC HV ACC3B]
3. 1 hp dc shunt motor eddy current load set-up [PEC HV ACC3C]
4. 1 HP 440 VDC shunt motor spring balance load set-up [PEC HV -ACC3D]
5. 1 hp 440vdc shunt motor generator load set-up [PEC HV-ACC3E]
6. 1 hp 440v dc shunt motor eddy current load set-up [PEC HV ACC3F]
7. 1 hp dc series motor spring balance load set-up [PEC HV ACC3G]
8. 1hp dc series motor generator load Set up [PEC HV ACC3H]
9. 1 hp dc series motor eddy current load set-up [PEC HV ACC3I]
10. 3 hp dc shunt motor spring balance load set-up [PEC HV ACC3M]
11. 3 hp dc shunt motor generator load set-up [PEC HV ACC3N]
12. 3 hp dc shunt motor eddy current load set-up [PEC HV ACC3O]
13. 1 hp single phase ac motor motor spring balance load set-up [PEC HV ACC3P]
14. 1 hp single phase acmotor, dc generator load set-up [PEC HV ACC3Q]
15. 1 hp single phase ac motor, eddy current load set-up [PEC HV ACC3R]
16. 1 hp three phase ac motor motor spring balance load set-up [PEC HV ACC3S]
17. 1 hp three phase acmotor, dc generator load set-up [PEC HV ACC3T]
18. 1 hp three phase ac motor, eddy current load set-up [PEC HV ACC3U]
19. 3 hp slip ring motor spring balance load set-up [PEC HV ACC3V]
20. 3 hp slip ring motor generator load set-up [PEC HV ACC3W]
21. 3 hp slip ring motor eddy current load set-up [PEC HV ACC3X]
22. 1 hp pmdc motor spring balance load set-up [PEC HV ACC3J]
23. 1 hp pmdc motor generator load set-up [PEC HV ACC3K]
24. 1 hp PMDC motor eddy current load set-up [PEC HV ACC3L]

1. 1 HP DC MOTOR LOAD SET-UP (PEC HV ACC3A)

This set up consists of one number of (1) dc shunt motor coupled with (2) mechanical spring balance load set-up with

DC Motor Spec

Power	1hp(.75kw)
Armature voltage	180vdc.5.1amp
Field voltage	220vdc,0.3amp
Speed	1500 rpm
Double side shaft extension.	
Make	benn

2. 1 HP DC MOTOR GENERATOR LOAD SET-UP (PEC HV ACC3B)

This set up consists of one number of (1) dc shunt motor coupled with (2) 1 HP dc shunt generator act as load

DC Motor Spec

Power	1hp(.75kw),shunt type
Armature voltage	180vdc.5.1amp
Field voltage	220vdc,0.3amp
Speed	1500 rpm
Double side shaft extension.	
Make	benn

DC Generator Spec

Power	1hp(6kw), shunt type
Armature voltage	180VDC, 2.7amp
Field voltage	220VDC, 0.3amp
Speed	1500 rpm
Double side shaft extension	
Make	benn

Both motor and generator are coupled with base plate.

3. 1 HP DC MOTOR EDDY CURRENT LOAD SET-UP (PEC HV ACC3C)

This set up consists of one number of (1) DC shunt motor coupled with (2) Eddy current load set-up

DC Motor Spec

Power	1hp(.75kw)
Armature voltage	180vdc.5.1amp
Field voltage	220vdc,0.3amp
Speed	1500 rpm
Double side shaft extension.	
Make	benn

Eddy Current Load set-up

1 hp rating
0-80v.1amp current rating
1500 rpm speed
Electronic dc voltage controller provided for torque variation
Torque sensor with torque indicator
Speed sensor with speed indicator
Both motor and eddy set-up coupled with base plate.

4. 440V DC MOTOR LOAD SET-UP (PEC HV ACC3D)

This set up consists of one number of (1) dc shunt motor coupled with (2) mechanical spring balance load set-up

DC Motor Spec

Power	1hp(.75kw)
Armature voltage	440vdc.2amp
Field voltage	220vdc,0.3amp
Speed	1500 rpm
Double side shaft extension	
Make	benn

5. 440V DC MOTOR GENERATOR LOAD SET-UP (PEC HV ACC3E)

This set up consists of one number of (1) dc shunt motor coupled with (2) 1 HP dc shunt generator act as load

DC Motor Spec

Power	1hp(.75kw),shunt type
Armature voltage	440vdc.2amp
Field voltage	220vdc,0.3amp
Speed	1500 rpm
Double side shaft extension.	
Make	benn

DC Generator Spec

Power	1hp(.6kw),shunt type
Armature voltage	180vdc,2.7amp
Field voltage	220vdc,0.3amp
Speed	1500 rpm
Double side shaft extension:	
Make	benn

Both motor and generator are coupled with base plate

6. 440 DC MOTOR EDDY CURRENT LOAD SET-UP (PEC HV ACC3F)

This set up consists of one number of (1) dc shunt motor coupled with (2) eddy current load set-up with (3) and torque indicator

DC Motor Spec

Power	1hp(.75kw)
Armature voltage	44vdc.2amp
Field voltage	220vdc,0.3amp
Speed	1500 rpm
Double side shaft extension.	
Make	benn

Eddy Current Load Set-up

1 hp rating
0-80v.1amp current rating
1500 rpm speed
Electronic dc voltage controller provided for torque variation
Torque sensor with torque indicator
Speed sensor with speed indicator
Both motor and eddy set-up coupled with base plate.

7. 1 HP PMDC MOTOR LOAD SET-UP (PEC HV ACC3J)

This set up consists of one number of (1) pmdc motor coupled with (2) mechanical spring balance load set-up with

PMDC Motor Spec

Power	1hp(.75kw).pmdc motor
Armature voltage	180vdc.5amp
Speed	1500 rpm
Double side shaft extension.	
Make	pranshu

8. 1 HP PM DC MOTOR GENERATOR LOAD SET-UP (PEC HV ACC3K)

This set up consists of one number of (1) pmdc motor coupled with (2) 1 HP PMDC generator act as load

PMDC Motor Spec

Power	1hp(.75kw).pmdc motor
Armature voltage	180vdc.5amp
Speed	1500 rpm
Double side shaft extension.	
Make	pranshu

PMDC Generator Spec

Power	1hp(.75kw).pmdc motor act as generator
Armature voltage	180vdc.5amp
Speed	1500 rpm
Double side shaft extension.	
Make	pranshu

Both motor and generator are coupled with base plate

9. 1 HP PMDC MOTOR EDDY CURRENT LOAD SET-UP(PEC HV ACC3L)

This set up consists of one number of (1) pmdc motor coupled with (2) eddy current load set-up

PMDC Motor Spec

Power	1hp(.75kw).pmdc motor
Armature voltage	180vdc.5amp
Speed	1500 rpm
Double side shaft extension.	
Make	pranshu

Eddy Current Load set-up

1 hp rating
0-80v.1amp current rating
1500 rpm speed
Electronic dc voltage controller provided for torque variation
Torque sensor with torque indicator
Speed sensor with speed indicator
Both motor and eddy set-up coupled with base plate.

10. 1 HP DC SERIES MOTOR LOAD SET-UP (PEC HV ACC3G)

This set up consists of one number of (1) DC series motor coupled with (2) mechanical spring balance load set-up

DC Motor Spec

Power	1HP(.75kw)
Armature voltage	220VDC,4amp
Speed	1500 rpm
Double side shaft extension.	
Make	benn

11. 1 HP DC SERIES MOTOR GENERATOR LOAD SET-UP (PEC HV ACC3H)

This set up consists of one number of (1) DC series motor coupled with (2) 1 HP DC shunt generator act as load

DC Motor Spec

Power	1HP(.75kw),series type
Armature voltage	220VDC.4amp
Speed	1500 rpm

Double Side Shaft Extension

Make	benn

DC Generator Spec

Power	1HP(.6kw),shunt type
Armature voltage	180VDC,2.7amp
Field voltage	220VDC,0.3amp
Speed	1500 rpm
Double side shaft extension.	
Make	benn

Both motor and generator are coupled with base plate.

12. 1 HP DC SERIES MOTOR EDDY CURRENT LOAD SET-UP (PEC HV ACC3I)

This set up consists of one number of (1) DC series motor coupled with (2) eddy current load setup

DC Motor Spec

Power	HP(.75kw)
Armature voltage	220VDC ,4amps
Speed	1500 rpm
Double side shaft extension.	
Make	benn

Eddy Current Load set-up

1 hp rating
0-80v.1amp current rating
1500 rpm speed
Electronic DC voltage controller provided for torque variation
Torque sensor with torque indicator
Speed sensor with speed indicator
Both motor and eddy set-up coupled with base plate.

13. 3 HP DC MOTOR LOAD SET-UP (PEC HV ACC3M)

This set up consists of one number of (1) DC shunt motor coupled with (2) mechanical spring balance load setup

DC Motor Spec

Power	3HP(2.2kw)
Armature voltage	180vdc.15.amp
Field voltage	220vdc,0.8amp
Speed	1500 rpm
Double side shaft extension.	
Make	benn

14. 3 HP DC MOTOR GENERATOR LOAD SET-UP (PEC HV ACC3B)

This set up consists of one number of (1) DC shunt motor coupled with (2) 1 HP dc shunt generator act as load

DC Motor Spec

Power 3HP(2.2kw),shunt type
Armature voltage 180VDC.15.1amp
Field voltage 220VDC,0.8amp
Speed 1500 rpm
Double side shaft extension.
Make benn

DC Generator Spec

Power 3HP(1.8kw),shunt type
Armature voltage 180VDC,7amp
Field voltage 220VDC,0.8amp
Speed 1500 rpm
Double side shaft extension.
Make benn

Both motor and generator are coupled with base plate.

15. 3 HP DC MOTOR EDDY CURRENT LOAD SET-UP (PEC HV ACC3C)

This set up consists of one number of (1) DC shunt motor coupled with (2) eddy current load set-up

DC Motor Spec

Power 3HP(2.2kw)
Armature voltage 180VDC.15.1amp
Field voltage 220VDC,0.8amp
Speed 1500 rpm
Double side shaft extension.
Make benn

Eddy Current Load Set-up

3 HPrating
0-80V,3amp current rating
1500 rpm speed
Electronic DC voltage controller provided for torque variation
Torque sensor with torque indicator
Speed sensor with speed indicator
Both motor and eddy set-up coupled with base plate.

16. 1 HP SINGLE PHASE INDUCTION MOTOR LOAD SET-UP (PEC HV ACC3M)

This set up consists of one number of (1) single phase ac motor coupled with (2) mechanical spring balance load set-up

AC Motor Spec

Power 1HP

Single phase permanent capacitor type 230VAC, 50Hz input

Speed 1400 rpm

Speed sensor with speed indicator

17. 1 HP AC MOTOR GENERATOR LOAD SET-UP (PEC HV ACC3B)

This set up consists of one number of (1) AC motor coupled with (2) 1 HP dc shunt generator act as load

AC Motor Spec

Power 1HP
Single phase permanent capacitor type 230V AC, 50Hz input
Speed 1400 rpm
Speed sensor with speed indicator

DC Generator Spec

Power HP(1.8kw),shunt type
Armature voltage 180VDC,7amp
Field voltage 220VDC,0.8amp
Speed 1500 rpm
Double side shaft extension.
Make benn

Both motor and generator are coupled with base plate.

18. 1 HP AC MOTOR EDDY CURRENT LOAD SET-UP (PEC HV ACC3C)

This set up consists of one number of (1) AC shunt motor coupled with (2) Eddy current load set-up

AC Motor Spec

Power 1HP
Single phase permanent capacitor type 230VAC, 50Hz input
Speed 1400 rpm

Eddy current load set-up

1 HP rating
0-80v,3amp current rating
1500 rpm speed
Electronic DC voltage controller provided for torque variation
Torque sensor with torque indicator
Speed sensor with speed indicator
Both motor and eddy set-up coupled with base plate.

19. 1 HP THREE PHASE MOTOR LOAD SET-UP (PEC HV ACC3M)

This set up consists of one number of (1) three phase ac motor coupled with (2) mechanical spring balance load set-up with (3) digital speed indicator

AC Motor Spec

Three phase squirrel cage induction motor.
Power 1HP(.75kw)
Current 1.8amp,star connection three phase 415VAC, 50Hz input
Speed 1390 rpm
Make Siemens/benn
Speed sensor with speed indicator

20. 1 HP THREE PHASE AC MOTOR GENERATOR SET-UP (PEC HV ACC3B)

This set up consists of one number of (1) three phase ac motor coupled with (2) 1 HP DC shunt generator act as load with (3) digital speed indicator

Vi Microsystems Pvt. Ltd., established in 1986, with a prime motto to "Design and Develop the Hardware and Software products" is headed by an educationalist and Ex-Scientist from Government of India, with the enormous experience gained in Research & Development. This organization had established to keep in tune with the developing technologies in the field of Electrical, Electronics, Instrumentation, Mechanical, Chemical etc.,

The Company has its own massive three-stroke building with a built in area of about 18,000 square feet in Chennai. The company has a effective work force of about 400 people working in various departments such as Sales, Service, R&D, Production, Quality Control, Finance, Purchase, Project etc. Each department has well stuffed Engineers and highly qualified Professionals working to achieve the objectives of the organization. The company has its own R&D wing recognized by Department of Scientific & Industrial Research, Government of India. By increasing its operations multifold the company could provide employment to more people in its various different departments.

To start with, the company was engaged in the manufacture of Microprocessor Trainers and Interface Boards. With the efforts from our Research and Development Team, the company has expanded its activities in various areas as follows. Microcontroller, Process Control Instrumentation, Digital Signal Processing, Power Electronics & Drives, Data Acquisition Systems, Personal Computer Trainer Systems, VLSI & Embedded Systems etc. Now our annual turnover is around Rs.30 Crores.

At present, the company is concentrating in various new fields like Advanced Control Systems, Solar Heat Pump Trainers, Advanced Process control, Chemical Reactors, Distillation Column, Image Processing, Nuclear Electronics, Defence projects etc.,

The Company also offer good sales support with effective service backup and technical support team. The company has built up a high degree of reputation and credibility by its dedicated after sales service support. The company also few export orders in Singapore, Malaysia, Tunisia, Ethiopia, Ghana etc.,

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